ORIGINAL MEMOIRS.

THE END RESULTS AFTER TOTAL EXCISION OF THE SCAPULA FOR SARCOMA.*

WITH STATISTICAL TABLES

BY CHARLES B. G. DE NANCREDE, M.D.,

OF ANN ARBOR, MICH.,

Professor of Surgery in the University of Michigan and in Dartmouth Medical College.

SOME thirty or more years ago, one of the most distin-
guished of English surgeons, the late Sir John Eric Ericsen,
is credited with saying that we had practically reached finality
in surgery—that there were no new fields to conquer, although
of course improvements in technic, and therefore better results,
were doubtless obtainable. Let us look back. What is left
of the old surgery? Has not cerebral, gastric, hepatic, in-
testinal, pulmonary, and cardiac surgery been born and grown
to lusty maturity since then? Are we assured against falling
into error similar to that of Sir John Ericsen? Certainly
not; and it seems to me that the bulk of the profession is
tending to perpetuate certain errors by keeping their eyes too
exclusively fixed upon improvements in mere technic, which
really determines much of our miscalled modern success. Our
wonderful immunity against wound infection, and our con-
trol of many of the factors making for dangerous shock,
seems to me to be leading us to perform numberless operations

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upon the plea that if not fatal from hemorrhage and shock—mostly preventable—operative recovery is sure to occur; as if satisfactory " end results " were not more important than temporary recovery—a somewhat doubtful blessing for the victims of malignant disease.

Do we not compile our statistics rather to demonstrate the success of our technic, so far as the immediate risk to life is concerned, rather than to show by the " end results," *i.e.,* what benefit has accrued to the patient? Would it not be well to lay to heart some advice of Sir W. H. Bennett's which I will quote. " It is well that we should beware lest a single predominant factor should be allowed to lead to our regarding, through a small tube only, a subject the horizon of which is absolutely unlimited. It has been said that the basis of surgery is handicraft, and this, in a sense, is true; but surely it is truth only half told," for " lying behind certain issues " to which I have referred, " is a far greater thing—the knowledge of when to apply that craftmanship of which everyone who now aspires to the practice of surgery should make himself a master. Nothing that has happened in the improvements connected with the practice of our art justifies, so far as I know, the modification by one iota of the edict of the great surgeon, who before advancing science had robbed operations of most of their horrors, said: " The all-important thing is not the skill with which you use the knife, but the judgment with which you discern whether its employment is necessary or not." Substituting the word " technic " for " handicraft," and " is worth while " for " is necessary," this quotation epitomises the object of my address.

To appraise correctly the propriety of any operation we must not only ascertain the immediate mortality, but the *ultimate mortality,* from failure to really cure, before we subject our patients to useless risks. At least, we should be able to say that a certain number, however small, are cured, or that the interval before recurrence is likely to be long. No one recognizes more readily than I do how unreliable statistics are; but if with monotonous regularity the " end

"result" is failure, at least we can be assured that this is vastly more likely to attend our future efforts than success, without any nice calculation of percentages,—and we shall cease to be self deceivers and blind leaders of our blinder but confiding patients.

In all business it is necessary to take stock from time to time, in order to ascertain whether our increasing income is a genuine return upon our invested capital, or whether we may not have impaired this and are gradually becoming bankrupt. So also in our profession it is wise to "take stock," as it were, to determine whether we really have made all the progress we claim, or whether, perchance, we have not diminished our capital of apparently well-grounded confidence, until the inevitable crash comes, revealing the true state of affairs, with its subsequent long-continued distrust of even conservative and genuine progress. This is well illustrated by the diametrically opposite advice given for the operative treatment of head injuries, during the eighteenth and nineteenth centuries. Should we find that real progress has been made, we can continue our practices; if partial advance alone has been secured, we must strive to render our success more complete; if real failure be the verdict of careful study, we must at once abandon that which has proved a broken reed, and start afresh in some new direction. Monumental conceit can alone oppose such periodic investigations, but those are unlikely to be welcomed with open arms who suggest the possibility that all which we now advocate and practice may not be good.

Following the example of one of my illustrious predecessors in this Presidential Chair, the late D. Hayes Agnew, instead of attempting to address you on some general subject, I shall strive to add my small contribution to the sum of more exact surgical knowledge. I have selected for investigation, total excision of the scapula for primary malignant disease. This of course practically means some form of sarcoma, since true carcinoma cannot be primary in bone. I am influenced in my choice because this is strictly a conservative opera-

tion for malignant disease of the bone, and because the local extirpation of all the neoplasm presents apparently most favorable conditions. Moreover, while not frequently performed, a sufficient number of cases are at everyone's disposal to guide us in deciding the following questions:

What are the probabilities as to operative death? Is there a material improvement in the numbers of the immediate survivals of the operations owing to our modern means for conserving blood? What are the chances for local recurrence, and are they early or late? Are early visceral metastases or recidives common? When operative recovery ensues, to what is the later death usually due? Is life much prolonged, and how much relief is effected by the operation? Can excision of the scapula be considered a curative operation, and if so, can this frequently be affirmed?

I shall endeavor to briefly settle for you these questions by the results of a study of all the recorded cases accessible to me in medical literature, and all unpublished cases with which the Fellows, and others have kindly supplied me by correspondence. A complete table of all unquestioned cases is appended, to enable the Fellows to review my conclusions if they so desire, and I must beg that they will judge of their correctness by glancing at the Tables (pages 8 to 17) as I read, these really constituting the body of my address.

I do not deny the possibility—indeed, the probability—that I have not secured reports of all total excisions of the scapula for malignant disease, and possibly more favorable results might thus be revealed if additional cases were unearthed, but after the exhaustive efforts I have made, I am convinced that no material change would be made in my conclusions.

A few words are requisite to explain the methods employed in the compilation of these tables, which differ widely from all their predecessors. Nothing so strongly impresses the conscientious student as the extraordinary inaccuracy of the tables purporting to be those of complete extirpations of the scapula. Many cases were really partial removals, or, sometimes, indeed complete removals, but done in two stages,

this latter method being a decidedly less dangerous operative procedure than complete removal at one sitting, although favoring local recidives and visceral metastases. Still further, cases are often admitted where portions of the clavicle or even the head of the humerus have been involved by the neoplasm and required removal; it is manifestly improper to include such cases in statistics purporting to be operations for disease restricted to the scapula, and is misleading as to the results of removal of the scapula alone.

A few cases have been included in my statistics where portions of the healthy clavicle, or even the head of the humerus have been removed. Such sacrifice of healthy bone tissue was to shorten the operation, to enable inadequate soft tissue flaps to cover the bones, or to mould the shoulder into better shape, not because of any trouble in the bones. Per contra in two instances in my tables small portions of the tip of the coracoid were left to facilitate operation, but in neither instance did these serve as the starting points for recidives, so far as is known (see cases of Gerster, No. 50, and of Bastiennelli, No. 59). It has seemed better to include these cases in the body of my statistics rather than to place them in the doubtful class, upon purely technical grounds.

In such cases it was thought that any increased risk of pyogenic or neoplastic infection of the cut osseous surfaces, or additional oozing, was more than counterbalanced by the greater certainty that no macroscopic diseased tissue was overlooked, and that the rapidity of the operation secured by cutting through, instead of disarticulating the clavicle or dissecting out the coracoid process, lessened both hemorrhage and shock. All such cases promptly recovered, thus showing that no additional operative risk was incurred.

Again, the most careful search throughout the whole domain of medical literature by myself and others, has failed to reveal any reliable information concerning certain cases found in nearly all tables. Their existence is not denied, only the propriety of quoting them is severely questioned. Even a case, which research showed was a removal of the scapula

after death, has been included by Karl Heldrich in his dissertation entitled, " Totale Resection der Scapula," München, 1903.

I can only attribute these blunders to the childlike confidence reposed by some in the accuracy of the headings of articles, inducing them to confine their researches solely to a perusual of the titles of reported cases, when a most cursory glance over the text would have shown the misleading character of these. In some few, the evidence advanced to prove that the disease was primary in, and confined to, the scapula has proved fallacious, a careful scrutiny of the history demonstrating that the neoplasm originated in contiguous muscles, this form of sarcoma being claimed by Butlin to be especially virulent as compared with bone sarcoma; these cases have been excluded or placed in the doubtful class. Contrary to the common practice, all cases where the microscopic picture and the subsequent clinical course proved that the growth was a pure enchondroma have been rigidly excluded from my tables. With still greater propriety, excisions for tubercular or pyogenic osteomyelitis and its consequences, are omitted, because in such cases if operative convalescence is secured, cure is effected, which certainly cannot be affirmed after operations for malignant disease. The inadequacy of the description of the microscopic appearances of one case of cyst of the bone following trauma, where no proper evidence of malignancy was supplied, led me to place this case in the " doubtful class."

Finally, from the later published reports, or by correspondence, some cases have been transferred from the cured class to the death column. From such researches I think that I am amply warranted in placing the question mark after cases which have made operative recoveries, but whose subsequent histories have extended only over a few months, and in some instances only a few weeks. The demonstrated inadequacy of the three years rule has led to its total disregard in this address, because a slavish and ignorant adherence to this artificial rule has led to many unwarranted statements upon which

has been founded erroneous practice. Under this rule recovery has been claimed while the reporter states that a late metastasis proved incapable of being radically treated.

All the statistics of the past, French, German, American, are absolutely misleading as to the operative mortality and end results of total excision of the scapula for primary sarcoma.

Although I have added twenty-two cases to those published in 1900 in Buchanan's tables, after a careful study of the literature by myself and two competent linguists, I have felt compelled to eliminate a number of cases, so that the total is slightly below that reported by Buchanan, for total extirpations, and upon which surgeons have relied since its publication in 1900. I wish here to acknowledge my indebtedness to this author both for his valuable tables and the information supplied me by his personal communications. I have also added two new cases to the second table comprising those where more than the scapula was involved in the malignant process.

A study of the 65 cases of malignant diseases tabulated, where the scapula alone seemed involved, has led to the surprising discovery that only one case is nearly certainly cured—MacDonald's, No. 39. Buchanan's case, No. 33, with hopeless metastases five years after excision of the scapula, should serve as a warning not to be over-sanguine. The following were probably cures, although in none had they been observed as long as Buchanan's. Case No. 4 of Syme's was well " several years " after the operation on the scapula, although this had been preceded by removal of the humeral head for a supposedly benign condition, and its admission to my list is perhaps of doubtful propriety.

Case No. 29 (Phelps) was believed to be well four years after amputation of the arm for recurrence. Cases 16, 38, 39, 46, 54, 60 and 61, were only followed for under four years. Accordingly we have one practically certain cure, and six probably cured, but one of these required a secondary operation and all may have relapsed later. Set against these

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TABLE I.—END RESULTS AFTER TOTAL

No.	Operator	Date of operation	Sex Age	Condition for which operation was done	Operative results
1	J. Syme, Edinburgh............ Buchanan's list, No. 2	Oct. 1, 1856	F. 70 yrs.	Cystosarcoma	Recovery
2	F. von Esmarch, Kiel......... Buchanan's list, No. 6	May 9, 1859	M. 33 yrs.	Sarcoma	Recovery
3	A. Hammer, St. Louis.......... Buchanan's list, No. 7	Oct., 1860	F. 18 yrs.	"Malignant growth" (Sarcoma)	Recovery
4	J. Syme, Edinburgh............ Buchanan's list, No. 8	Nov. 13, 1862	M. 45 yrs.	"Malignant growth" (Sarcoma)	Recovery
5	M. Michaux, Louvain.......... Buchanan's list, No. 9	Nov. 24, 1864	M. 15 yrs.	"Encephaloma" (Sarcoma)	Recovery
6	S. Rogers, New York.......... Buchanan's list, No. 11	Dec. 12, 1867	F. 7 yrs.	Carcinoma (Sarcoma)	Recovery
7	G. Pollock, London............ Buchanan's list, No. 13	Sept. 30, 1869	M. 47 yrs.	"Vascular growth" (Sarcoma)	Death
8	C. Steele, Bristol............... Buchanan's list, No. 14	April 18, 1871	F. 8 yrs.	Encephaloid (Sarcoma)	Recovery
9	K. King, Hull................. Buchanan's list, No. 15	June 17, 1871	F. 8 yrs.	Carcinoma (Sarcoma)	Recovery
10	J. Spence, Edinburgh.......... Buchanan's list, No. 17	Feb. 21, 1872	M. 66 yrs.	"Malignant growth" (Sarcoma)	Recovery
11	R. Schnieder, Königsburg....... Buchanan's list, No. 19	Dec. 3, 1873	M. 6 yrs.	Sarcoma	Recovery
12	Wm. MacCormac, London Buchanan's list, No. 21	May 10, 1876	F. 29 yrs.	"Myxochondroma" Myxochondro-sarcoma (?)	Recovery

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Later history	End results	Remarks	Reference
No recurrence during two months, patient survived	Died in 2 m.	Exhaustion and old age, yet no adequate cause for exhaustion is given. Were there metastases in the organs essential to life?	Medico-Chirurgical Trans., London, 1857, vol. xl, p. 507.
Recurrence early	Died in 6 m.	Part of clavicle removed—apparently healthy—to facilitate operation	Archiv f. klin. Chirurg., 1863, vol. iv, p. 584
Recurrence early	Died 10 m. after operation	Three-fourths of inch of clavicle removed to facilitate operation	St. Louis Med. Rep., 1866, vol. i, p. 7.
No recurrence "several years later"	Recovery	Head of humerus had been previously removed for chondroma(?) It is somewhat questionable whether this case should be classed as an excision of the scapula in view of the previous operation	Syme, Excision of the Scapula, Edinburgh, 1864.
Rapid development of mediastinal growth	Death in 10 m.	. . . .	Gaz. Méd. de Paris, 1866, p. 313.
Rapid recurrence	Death in 6 m.	Carcinoma not being primary in bone, the growth must have been sarcoma	Amer. Journal Med. Sciences, 1868, vol. lvi, p. 359
Bronchopneumonia aggravated by the chloroform	Died on 5th d.	Part of clavicle removed because thought to be "slightly eroded." Were not the apparent bronchitic symptoms probably due to undetected pulmonary metastases giving rise to active symptoms from the irritant effects of chloroform?	St. George's Hospital Reports, 1869, vol. iv, p. 233.
Recurrence in less than seven weeks; this was removed but was followed by another in two weeks, which proved inoperable	Died middle of Sept. 1871, about 5 m.	Secondary operation at 7 weeks followed by hopeless recurrence	Brit. Med. Journal, 1871, vol. ii, p. 430.
No recurrence 2 years later	Recovery(?)	Too early for definite results, as many cases die from recurrence or metastasis much later	Liverpool and Manchester Med. and Surgical Reports, 1874.
(?)	Died in 6 m.	Careful scrutiny of the history shows that bronchitic(?) symptoms existed before operation, continued with varying intensity during so-called "convalescence," culminating in death from "capillary bronchitis;" no post-mortem. The whole pulmonary condition was almost certainly due to lung metastases preceding operation	Dublin Journal of the Medical Sciences, 1873, vol. lv, p. 508.
Generalization	Died in 4½ m.	Uninvolved portion of clavicle removed to facilitate operation	Berlin. klin Wochensch., 187, vol. xi, p. 377
Recurrence	Died Nov. 12, 1876, 6 m. after operation	Clavicle divided just internal to coracoid process for convenience. So-called myxochondromata contain genuine sarcomatous tissue if all portions of the growth are carefully examined in almost every instance	St. Thomas's Hospital Reports, 1876, vol. vii, p. 307.

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No.	Operator	Date of operation	Sex Age	Condition for which operation was done	Operativ results
13	J. Spence, Edinburgh............ Buchanan's list, No. 25	1877	.. ..	"Tumor"	Death
14	G. A. Peters................... Buchanan's list, No. 26	Jan. 11, 1878	M. 42 yrs.	Carcinoma (Sarcoma)	Recover
15	F. A. Nixon................... Buchanan's list, No. 28	Nov., 1881	M. 13 yrs.	Sarcoma	Recover
16	A. Roth, Cagliari.............. Buchanan's list, No. 29	Jan. 14, 1884	M. 33 yrs.	Myxosarcoma	Recover
17	Geo. W. Gay, Boston........... de Nancrède	Feb. 1, 1884	M. 23 yrs.	Sarcoma	Recover
18	Mr. Ellison................... Buchanan's list, No. 30	July 7, 1884	M. 13 yrs.	Sarcoma	Recover
19	Lannelongue.................. Buchanan's list, No. 33	Mar. 5, 1885	M. 34 yrs.	Chondrosarcoma	Death
20	J. H. Brinton................. Buchanan's list, No. 34	Oct. 3, 1885	F. 11 yrs.	Sarcoma	Death
21	H. Trendelenburg, Bonn........ Buchanan's list, No. 37	Nov. 16, 1886	M. 42 yrs.	Sarcoma	Recover
22	T. F. Chavasse, Birmingham.... Buchanan's list, No. 41	Feb., 1888	F. 8 yrs.	Sarcoma	Death
23	P. Sendler, Magdeburg......... Buchanan's list, No. 43	May 2, 1888	F. 23 yrs.	Sarcoma	Recover
24	J. Van der Hoeven, Jr.......... Buchanan's list, No. 44	Mar. 7, 1889	M. 4½ yrs.	Sarcoma	Recover
25	M. Perier.................... Buchanan's list, No. 45	Oct. 14, 1889	M. 55 yrs.	Sarcoma	Recover
26	Putti....................... Buchanan's list, No. 46	1889	M. 45 yrs.	Sarcoma	Recover
27	J. Israel, Berlin............... de Nancrède	July 6, 1890	M. 38 yrs.	Sarcoma	Recover
28	Hadra, Erlangen.............. Buchanan's list, No. 48	Jan. 13, 1891	M. 59 yrs.	Sarcoma	Recover
29	A. M. Phelps, New York........ Buchanan's list, No. 49	Nov., 1891	M. 42 yrs.	Fibroma by pathologists. Because of recurrence, growth was evidently fibrosarcoma	Recover
30	Putti....................... Buchanan's list, No. 50	1891	....	Sarcoma	Recover
31	W. H. A. Jacobson, London..... Buchanan's list, No. 51	March, 1892	F. Adult	Sarcoma	Recover
32	M. Folet of Lille.............. Buchanan's list, No. 53	April 14, 1893	F. 19 yrs.	Sarcoma	Recover

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Later history	End results	Remarks	Reference
. . . .	Died	Clavicle divided near acromial end to facilitate operation. Nothing beyond statement that operation was done and result	Lectures on Surgery, 3rd Ed., vol. ii, p. 1107.
No recurrence at last report at the end of 3 months	Recovery(?)	Too early for definite end results	Amer. Journal of Med. Sciences, 1878, vol. lxxvi, p. 100.
Last record only few weeks after operation	Recovery(?)	Too early for definite end results	Brit. Med. Journal, 1881, vol. ii, p. 1056.
No recurrence in 1888, according to Tito Costa in Buchanan's table	Recovery(?)	Reasonably certain recovery, although may have recurred later	Melis, Extirp. della Scapola, Cagliari, 1886; Arch. di Ortop. Anno 10, No. 2, 1893. Buchanan's letter to author
Recurrence and death inside of the year	Death in less than a year	. . . .	Personal letter to de Nancrède.
No record after report in journal	Recovery(?)	. . . .	Austral. Med. Gaz., 1884, vol. iv, p. 39.
. . . .	Died in 36 h. Shock	Alcoholic subject	Leçons clinique Chir., Paris, 1885, p. 235.
. . . .	Died 1 h. from shock	. . . .	Maryland Med. Journ., 1885–6, vol. xiv, p. 21.
Recurrences Feb. 8, 12, 26	Died in 18 m.	. . . .	Trottmann, Ueber die Extirp. der Scapula, 1887
. . . .	Died same day	. . . .	Lancet, London, 1892, vol. ii, p. 471.
Sarcomatosis of lung, local recurrence	Death on 14th day	. . . .	Arch. f. klin. Chirurg., 1889, vol. xxxviii, p. 300.
No recurrence at the end of 15 months	R(?)	Too early to determine end results	Nederl. Tydschr., v,. Geneesk, 1890, vol. xxvi, p. 521.
Last report Feb. 4, 1890	R(?)	Too early to determine end results	Le Mercredi méd., 1890, p. 51.
Lethal cause "Enterocolitis"	Died in 14 m.	Too early to determine end results	Riforma med. Napoli, May 1, 1891.
Sarcomatosis of liver, right pleura, and probably left lung	Died in 1 y.	. . . .	Berlin. klin. Wochenschr. vol. xxxiii Nov., p. 987–8.
Recurrence 1 month, operated. Second recurrence, operation attempted, abandoned	Died in 10 w. Sepsis	Head of humerus removed because of paucity of soft part covering	Hausmann, Ueber die totale extirpat. des Schulterblattes, 1892, Erlangen.
Recurrence and removal of arm July 3, 1895(?)	R	Well February, 1900	Medical and Surgical Reporter, Phila., Sept. 9, 1893; Personal communication to Dr. Buchanan.
No further data after May, 1891	R(?)	. . . .	Riforma med. Napoli, May 1, 1891.
Well two years later when last seen	R(?)	Too early to determine end results	The Operations of Surgery, London, 1897, p. 151; also personal letter Dec. 4, 1908.
Reported during same year	R(?)	Too early to determine end results	Bull. méd. du Nord., 1893, vol. xxxii, p. 305

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No.	Operator	Date of operation	Sex Age	Condition for which operation was done	Operativ results
33	J. J. Buchanan, Pittsburgh...... Buchanan's list, No. 56	Mar. 15, 1894	M. 34 yrs.	Sarcoma	Recover
34	Madelung, Strasburg........... Buchanan's list, No. 58	Mar. 5, 1895	F. 23 yrs.	Sarcoma	Recover
35	A. B. Johnson, New York....... Buchanan's list, No. 59	Oct. 9, 1895	M. 45 yrs.	Sarcoma	Recover
36	J. C. Warren, Boston........... Buchanan's list. No, 60	Dec. 28, 1895	M. 14 yrs.	Sarcoma	Recover
37	R. F. Weir, New York.......... de Nancrède	1895	M. Adult	Sarcoma	Recover
38	J. C. MacDonald, San Francisco. Buchanan's list, No 61	Jan. 31, 1896	F. 25 yrs.	Sarcoma	Recover
39	T. K. Dalziel, Glasgow.......... Buchanan's list, No. 62	Feb, 1896	M. 36 yrs.	Sarcoma	Recover
40	J. Israel, Berlin................ de Nancrède	April 6, 1896	M. 36 yrs.	Myxochondro- sarcoma	Recover
41	F. J. Shepherd, Montreal........ de Nancrède	June 26, 1896	F. 33 yrs.	Myeloid sarcoma	Recover
42	G. H. Eddington, Glasgow...... Buchanan's list, Ho. 64	Dec. 27, 1896	F. 8 yrs.	Sarcoma	Recover
43	J. E. van Iterson, Leyden ...... Buchanan's list, No. 65	Jan. 22, 1897	F. 30 yrs.	Sarcoma	Recover
44	A. W. Mayo Robson, Leeds, now London.................... Buchanan's list, No. 67	July 20, 1897	F. 20 yrs.	Sarcoma	Recover;
45	G. B. A. Moynihan, Leeds....... Buchanan's list, No. 68	Sept. 16, 1897	F. 23 yrs.	Sarcoma ·	Recoverl
46	L. Piqué, Paris................ Buchanan's list, No. 69	Oct. 26, 1897	F. 25 yrs.	Sarcoma	Recoverl
47	Wm. T. Bull................ de Nancrède	Nov., 1897	M. 52 yrs.	Fibrosarcoma	Death in few hour from sho

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Later history	End results	Remarks	Reference
A growth had been removed 4 months before scapula was excised	Died after 5 y.	Inoperable recurrence in upper jaw	Phila. Med. Journ., 1900, vol. vi, pp. 7–82.
Local recurrence Apr. 26; removed: local recurrence June 10; op. refused	Died in 5 m.	Disease in central end of humerus and outer portion of clavicle. Died Aug. 10, 1895	Deutsche Zeitschr. f. Chir. 1896, vol. xliii, p. 443.
Reported well at end of about 1897 by letter to author dated Dec. 5, 1908	R(?)	Too early to determine end results	New York Med. Journ., vol. lxiii, p. 389, also personal letter (1908) to author.
Operated twice during 1896 for recurrences	R(?)	Drowned over year after primary operation	Boston Med. and Surg. Journ., 1896, vol. cxxiv, p. 511. Personal letter to author, 1908.
Traced only about 2 months	R(?)	Too early to determine end results	Personal communication to author.
Well at last observation 5 years after operation	R	Permanent recovery probably certain	Occidental Med. Times, 1896, vol. x, p. 600. Also personal letter to author, Dec. 15, 1908
Well Feb. 1900 (4 yrs.) by personal letter to Dr. Buchanan	R	Permanent cure highest degree probable	Glasgow Med. Journ., 1897, vol. xlvii, p. 140
Resection of head of humerus had been done one year previously by Gruber of Charkow for enchondroma	R(?)	Too early to determine end results. Somewhat doubtful if this case should be included in this list	Berlin. klin. Wochenschr., vol. xxxiii, pp. 987–988.
Lung metastases recognized in October, 1898	Died July, 1899, a little over 3 y.	....	Montreal Med. Journ., vol. xxv, 1896–97; personal letter to author giving final results, Dec. 9. 1908.
....	Died in 17 m. Generalization	Generalized metastasis (see second reference)	Glasgow Med. Journ., 1897, vol. xlviii, p. 202. Brit. Med. Journ., 1901, vol. x, pp. 954–5, April 20.
Sensory anæsthesia and deficient circulation led van Iterson to remove the arm about Jan. 29., 1897	R?	No evidence as to what end results were	Personal communication to Dr. Buchanan, who in reporting the case leads the reader to infer that there was an operative recovery.
Sarcoma of lung	Died Sept. 10, 1899, about 13 m.	....	Personal communication to Dr. Buchanan.
Rapid recurrence at operative site in 22 days, when an operation was done	Died in 37 d.	....	Brit. Med. Journal, 1898, vol. i, p. 1198.
In 1900 condition was reported as good	R(?)	External third of clavicle normal but removed to facilitate operation	Bullet. Soc. Anat. de Paris, vol. lxxii, 1897, p. 919. Piqué et Dartigues, Rev. de Chir., Paris, vol. xxi, pp. 437–488.
....	Death	....	Extract from records of New York Hospital secured by the kindness of Dr. F. W. Murray.

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TABLE I.—END RESULTS AFTER TOTAL EXCISION

No.	Operator	Date of operation	Sex Age	Condition for which operation was done	Operative results
48	M. Schmidt, Cuxhaxen.......... Buchanan's list, No. 70	Dec. 5, 1897	M. 57 yrs.	Sarcoma	Recovery
49	Dr. Tricomi, Rome............. de Nancrède	1899(?)	M. 47 yrs.	Myxochondrosar- coma	Recovery
50	A. Gerster, New York.......... de Nancrède	July 11, 1899	M. 8 yrs.	Sarcoma	Recovery
51	C. H. Golding-Bird, London..... Buchanan's list, No. 72	Jan. 10, 1900	F. 10 yrs.	Sarcoma	Recovery
52	E. Quenu and G. Renon........ de Nancrède	July 23, 1902	M. 16 yrs.	Sarcoma	Recovery
53	Rotter, operated by Gunkel..... de Nancrède	1903	....	Endothelioma (Sarcoma)	Recovery
54	C. M. Stemen, Kansas City...... de Nancrède	March, 1904	M.	Sarcoma	Recovery
55	A. Nota..................... de Nancrède	Mar. 12, 1904	M. 46 yrs.	Sarcoma	Recovery
56	Chas. C. Allison, Omaha........ de Nancrède	....	....	Sarcoma	Recovery
57	G. W. Crile, Cleveland.......... de Nancrède	....	M. 12 yrs.	Sarcoma	Recovery
58	P. Bastienelli, San Giovanni Valdarno .... de Nancrède	Feb. 20, 1905	F. 9 yrs.	Sarcoma "Myelogenic osteosarcoma"	Recovery
59	F. J. Lutz, St. Louis.......... de Nancrède	April, 1905	M. 31 yrs.	Sarcoma	Recovery
60	J. J. Buchanan, Pittsburg....... de Nancrède	July 1, 1905	F. 18 mos.	Sarcoma	Recovery
61	C. B. G. de Nancrède, Ann Arbor de Nancrède	Feb. 1, 1906	M. 28 yrs.	Sarcoma	Recovery
62	L. A. Dunn, London........... de Nancrède	Nov. 7, 1904	M. 35 yrs.	Sarcoma	Recovery
63	M. Lejars, Paris.............. de Nancrède	July 9, 1908	F. 24 yrs.	Sarcoma	Recovery

OF THE SCAPULA FOR SARCOMA—*Continued*

Later history	End results	Remarks	Reference
Local recurrence at end of one year; a metastatic growth at exit of one sciatic nerve from pelvis	Probably (?) fatal. Last trace Jan. 13, 1899	Secondary growths in axilla were removed once	Deutsche Zeitschr. für Chir., 1898–99, vol. 1, p. 394.
Traced only one month after operation	R(?)	Too early to determine end results	Extirp. completa della Scapola per sarcoma. Arch. ed atti d. Soc. Ital. di Chir. 1899, Roma, 1900, vol. xiv, pp. 263–264.
No record beyond one month	R(?)	Too early to determine end results	Festschrift, Abraham Jacobi, May 6, 1900, p. 124.
No record beyond one month	R(?)	Entirely too early for any definite end results	Personal communication to Dr. Buchanan.
Record of barely 4½ months	R(?)	Too early for any definite end results	Rev. de Chirurg., Paris, vol. xxvii, pp. 421–436.
Several weeks later head of humerus removed to facilitate healing; died of "croupous pneumonia"	Died 4 m.	Was not the "croupous pneumonia" really pulmonary sarcomatosis, producing consolidation and a simulation of genuine pneumonia?	Deutsche Wochenschr. Vereins-Beilage, vol. xxix, p. 177.
None, but information inadequate	R(?)	Alive in 1908	Personal letter to author.
Last report 6 months after operation	R(?)	Too early for end results	Gior. d. R. Acad. di Med. di Torino, 4, S. vol. x, pp. 651–657.
Visceral metastasis in two years	Died soon after secondaries appeared	....	Personal letter to author.
Early intrathoracic metastases	Died in 6 m.	....	Personal letter to author.
Well on Dec. 15, 1908, as reported by operator to author by letter	R(?)	Tip of coracoid left to facilitate operation. Enlarged axillary gland removed nearly two years later. Was well Dec. 15, 1908	Sopra un caso di extirpas totale della scapola sinistra, Polyclinico, Roma, vol. xiv, sez. prat., pp. 97–102. Personal letter Dec. 15, 1908.
....	R(?)	Reported well 32 months	Surgery, Gynecology and Obstet., Chicago, vol. iv, pp. 11–12. Personal letter Dec. 13, 1908.
Discharged within one week; later news, Jan. 22, 1909, well	R	Perfectly well Jan. 22, 1909	Personal letter to author. Jan. 15, 1909. Letter from father 1–22–1909. Kindly sent me by Dr. Buchanan.
Marked recurrence (inoperable) by Aug. 24, 1906; soon after "became numb from breast down, with secondaries probably in the dorsal vertebræ	Died of recurrence and generalization, 4 mos. 19 days	Died July 19, 1906	Hospital Record, University of Michigan.
Reported well nearly two years after operation. In 1907(?) extensive local recurrence and death	Death in about 3 y.	....	Brit. Med. Journ., March 26, 1908. Personal letter of Jan. 9, 1909 to author.
Latest report, 3 months	R(?)	Clavicle divided for convenience. Too early for determination of end results	Sarcome de l'omoplate gauche, ablation totale de l'omoplate. Bull. et Mém. Soc. de Chir. de Paris, N. S., vol. xxxii, pp. 802–4.

TABLE I.—END RESULTS AFTER TOTAL EXCISION

No.	Operator	Date of Operation	Sex Age	Condition for which operation was done	Operative results
64	S. McEwen, Orlando, Florida.... de Nancrède	Jan. 25, 1908	M. 26 yrs.	Endothelioma (Sarcoma)	Recovery
65	F. N. Pryanishnikov........... de Nancrède	1908	M. 7 yrs.	Sarcoma	Recovery

TABLE II.—CASES WHERE MORE THAN THE SCAPULA WAS INVOLVED BEING REMOVED AT ONE SITTING WITH PRESERVATION

No.	Operator	Date of Operation	Sex Age	Condition for which operation was done	Operative recovery
1	Von Langenbeck, Berlin........ Buchanan's list, Case 1	May 22, 1855	M. 12 yrs.	"Malignant growth" (Sarcoma?)	Recovery
2	M. Michel, Strasburg........... Buchanan's list, Case 12	Sept. 20, 1868	M. 50 yrs.	Cyst of bone, almost certainly benign	Recovery
3	J. Spence, Edinburgh........... de Nancrède	Dec. 25, 1871	M. 68 yrs.	Tumor	None
4	G. Poinsot, Bordeaux........... Buchanan's list, No. 31	Sept. 6, 1884	M. 52 yrs.	Sarcoma	Death
5	A. MacCormac, Sidney.......... Buchanan's list, No. 38	April, 1887	M. 56 yrs.	Sarcoma, primary in muscle	Recovery
6	C. H. Golding-Bird, London..... Buchanan's list, No. 52	Mar. 28, 1893	F. 14 yrs.	Sarcoma	....
7	P. Berger, Paris................ Buchanan's list, No. 66	June 2, 1897	F. 21 yrs.	Sarcoma	Recovery
8	C. M. Stemen, Kansas City...... de Nancrède	Nov. 14, 1899	M. 51 yrs.	Sarcoma	Recovery
9	M. Poisson................... de Nancrède	1905	M. 30 yrs.	Sarcoma	Recovery

OF THE SCAPULA FOR SARCOMA—*Continued*

Later history	End results	Remarks	Reference
Last accessible report less than seven months after operation	R(?)	Too early to determine end results	Journal of the Amer. Med. Association, vol. li, Aug. 29, p. 757.
Inoperable metastases in less than 2 months on head	Died. Exact time not given	Resection of the head of the humerus and portion of the clavicle " for the purpose of securing a better joint," but they were apparently uninvolved by the neoplasm	Khirurgia, Mosk., vol. xxiii, pp. 141–148.

IN THE NEOPLASM, ALL OF THE SUPPOSEDLY DISEASED TISSUES OF THE REMAINDER OF THE UPPER EXTREMITY.

Later history	End results	Remarks	Reference
Recurrence in 109 days	Died in 3½ m.	Three inches of clavicle removed because imbedded and involved in the growth	Fock, Deutsche Klinic, 1855, No. 38, p. 422.
No recurrence	Recovery lasting over 5 y.	Microscopic description indicates probably a relatively benign myeloid growth	Levrey, Resection complète du Scapulum, 1869; also Case 3 of Heldrich, Totale Resectionen der Scapula, Diss. 52 p., Muenchen; Also Gaz. Hebdom. de méd., Paris, vol. ii, pp. 432–435.
Rec.?	. . . .	Clavicle divided for convenience. Clinical diagnosis; malignant. Course pursued and microscopic appearances left Mr. Spence in doubt.	Lect. on Surg., 3d ed., vol. i, p. 963 et seq.
No time for recurrence	Died in 2 d.	Outer portion of clavicle involved and removed; head of humerus excised for better shaped shoulder. "Gangrene gazeuse"	Rev. de Chir., Paris, 1885, vol. v., p. 201.
Operation for recidives June and December 1889; patient well 1898	R	Acromium sawn across at base and left. Growth primary in serratus magnus muscle, later involving scapula, the recidives, required removal of portions of the external intercostals; cautery freely employed	Australasian Med. Gaz., 1898, vol. xvii, p. 295.
Recurrence in wound and axilla	Died in 1 y. 5 d.	A part of the clavicle was involved in the disease and removed	Lancet, London, 1893, vol. i, p. 1066; also personal communication to Dr. Buchanan.
Recurrence of growth excised early in 1899	R(?)	Latest report March 1900; too early for definite end results. Primary growth was in the trapezius, secondary in the scapula and clavicle, a portion of the latter being removed	Bull. et Mém. Soc. Chir. de Paris, 1897, vol. xxiii, p. 571. Later personal letter to Buchanan.
Removal of one half of clavicle because involved by the neoplasm	Died 19 hours after operation	. . . .	Personal letter to author.
No definite after history	R(?)	Curettage of a neoplastic area in the head of the humerus	Ablation totale d'omoplate. Gaz. Méd. de Nantes, 2. S. vol. xxiii, pp. 114–115.

successes (?) the cases of the following patients whose records
are complete, who died from the operation or its results, or
from either recidives or metastases, or where the data were
too incomplete to determine the " end results."

Case number.   Results.
  1. Died in two months.
  2. Died in six months.
  3. Died in ten months.
  4. Apparent recovery, already referred to.
  5. Died in ten months.
  6. Died in six months.
  7. Died on fifth day.
  8. Died in five months.
  9. No data after two years.
 10. Died in six months.
 11. Died in four and one-half months.
 12. Died in six months.
 13. Died, no date.
 14. Observed three months.
 15. Observed few weeks.
 16. Probable cure.
 17. Died under one year.
 18. Died in a few months.
 19. Died in thirty-six hours.
 20. Died in one hour.
 21. Died in eighteen months.
 22. Died on same day.
 23. Died on fourteenth day.
 24. Died in fifteen months.
 25. Died in three and one-half months.
 26. Died in fourteen months.
 27. Died in one year.
 28. Died in ten weeks.
 29. (Phelps) probably cured.
 30. Observed only a few months.
 31. Observed only two years.
 32. Died under one year.
 33. Died in over five years.
 34. Died in five months.
 35. Observed only about two years.
 36. Drowned about four years after last operation.
 37. Traced only about two months.
 38. Died from recurrence after sixth year.
 39. Probable cure.
 40. Only a few months.
 41. Died in three years.
 42. Died in seventeen months.

Case number.   Results.

43. No later history.
44. Died in thirteen months.
45. Died in thirty-seven days.
46. Probable cure but too early for reliable results.
47. Died in probably two years.
48. Only traced one month.
49. Only traced one month.
50. No record beyond one month.
51. Record only four and one-half months.
52. Died in about four months.
53. Possible cure.
54. Record only six months.
55. Died in over two years.
56. Died in six months.
57. Nearly three years, possible cure.
58. Observed thirty-two months.
59. Observed over three and one-half years.
60. Observed three years and seven months, then well.
61. Died in five months.
62. Died in three years.
63. Observed only three months.
64. Observed less than seven months.
65. Died from early inoperable cranial growths within less than two months.

Cases 48, 49, 50, 51, 53, 57, 58, 63, 18 and 63 have no reliable record as to " end results," having data lasting perhaps only one week, one month, four and a half, six months, up to and at most thirty-two months in one case. In the light of the evidence of recurrence, as shown by the records of other cases already quoted, who can doubt that the " end results " if known, would be as bad as those already finally determined, *i.e.,* usually death, possibly one or two recoveries.

Putting the facts in another way, out of 65 cases, 26 were dead in less than one year, 3 were dead inside of eighteen months, 2 survived two years, 2 lived for three years and 1 for five years before succumbing. Thirty-five then died inside of two years—over one-half.

Of the 9 cases included in my second table where disease had invaded the surrounding tissues requiring their removal, and including two cases where the diagnosis was doubtful, the showing is not materially better.

Case No. 1 died in three and one-half months; Case No. 2 was well over five years but the malignancy of the growth is much in doubt; No. 4 died in two days from wound infection; No. 5 where the growth was secondary in the scapula was well nine years later after repeated operations; No. 6 died in one year and five days; No. 7 was only observed about one year; No. 8 died in nineteen hours; while concerning Nos. 3 and 9 there is no definite history.

To what conclusions does this sorry showing drive us? That except under peculiarly advantageous conditions, we cannot hope for much prolongation of life, and still more rarely for a permanent cure. This latter can only be secured by a very early operation—almost as soon as the growth is diagnosed. Unfortunately, in certain instances, even the earliest possible intervention will prove unavailing, probably owing to the unusually favorable relations of the minute blood-vessels of the growth to the neoplastic cells, presenting facilities for their embolic dissemination.

The probabilities as to operative death; whether recoveries are more common than in the past; the probabilities of local or general recurrence; whether these are early or late; to what late death is due when operative recovery occurs; and can excision of the scapula be considered a curative operation, are best and most fully answered by a study of my tables,—nevertheless, I shall dwell chiefly upon some of these points. One question as to whether life is prolonged when death results from recidives or generalization cannot be answered, as there are no data securable as to the natural history of unoperated sarcomata of the scapula.

Study of the literature reveals other data than those which I can now give, showing how commonly recurrence in loco takes place, and how probable it is that the recidives provide the foci whence generalization occurs, the primary growth having been removed before metastases had taken place; hence, if local recurrence is preventable by earlier operation, a certain number of fatal cases of visceral involvement might be avoided. At once the question suggests itself, might not an

interscapulo-thoracic amputation instead of an excision of the scapula render possible a much wider extirpation of the tissues in which recidives occur, and thus lead to a greater number of permanent recoveries? The evidence on this point I have not attempted to secure but would urge that this investigation be made in the near future by some one of the Fellows.

The commonly accepted reasons for the early metastases by the vascular system are too well known to need mention, but I believe clinically, too much stress is unwittingly placed upon one fact and too little upon another, unconsciously creating a tendency to fall into a most serious error. Because lymph-node infection is a not uncommon possibility in sarcoma of bone, in the absence of any such complication, when no obvious visceral metastases are detectable, we too often ignore the probability of the presence of innumerable minute metastatic deposits in the lungs and other organs, which from their small size, their number and uniform dispersion throughout the viscera, defy detection by the most expert diagnostician *at the time of operation,* too often to demonstrate their fatal presence after all the primary focus has been thoroughly removed, and where no recidives appear in situ, whence the generalization could have occurred.

While my tables cannot be made to show in a definite way the propriety of these statements, the extended histories of many of these cases fully warrant my assertions.

Although these cases do not appear to bear upon the question of the lessened operative mortality of excision of the scapula, operative removal of the scapula for other conditions as well as the more recent cases included in my tables, show that total excision of the scapula is somewhat less dangerous than formerly. Possibly some patients who died in the past of shock and hemorrhage, had they survived would have shown additional cures, so that the probabilities of slightly improved " end results " may be anticipated. If this operation is performed for unquestionably benign growths, it is entirely proper and should prove increasingly successful. Percentages, as be-

fore stated, are misleading rather than informing, hence none such will be given.

Certainly metastases and recidives are common, if indeed metastases have not already occurred before operation, but have been overlooked.

With very few exceptions, all complete histories sooner or later show that death resulted from local recurrences or generalization throughout the economy.

Although I am unwilling to take an extreme position, if the positive diagnosis of malignant disease can be made, I shall, I think in the future, recommend early intercostohumeral amputation, until this procedure is also proved to be inferior, or no better, in the " end results " than complete excision of the scapula alone, and I shall set my face absolutely against any partial resections of the shoulder-blade for malignant disease.

No one can deny that retention of the remainder of the upper extremity is desirable, and that it is always of some utility, while in many the ability to use the arm is surprisingly good. Nevertheless, life should be considered first, utility last.

None would be more pleased than I to have my gloomy forecasts disproved, but I cannot shut my eyes to what I have learned from a study of the literature of the subject. The outcome of my investigations was a complete surprise to me, as I anticipated a far different result.

In conclusion, permit me to ask a careful consideration of my tables, prepared only after the consumption of a vast amount of time and study and which have led to such unforeseen conclusions. I would also insist upon the propriety of the application of similar methods to the study of some of our accepted plans of treating other diseases. This is not my first experience of the disillusionizing effects of a study of " end results." A number of years ago I read a paper in Chicago, where my own experience and that of others to which I had access, demonstrated *by the end results,* the almost certainty of ultimate failure to cure focal and Jacksonian epilepsies by the excision of the discharging cerebral lesions.

THE OLD, AND THE BEGINNING OF THE NEW, IN SURGERY.*

BY J. EWING MEARS, M.D.,

OF PHILADELPHIA.

IT has happened to the writer to have lived in one of the World's periods of greatest activity and progress. It may be questioned whether the last half of the Nineteenth Century cannot claim the maximum of development in those conditions which have contributed to the improvement of man's stay on earth. In considering these conditions, and the influence exerted by them, it must not be forgotten that the foundation upon which they are builded and upon which they rest, took origin at the very beginning of man's existence—at the dawn of creation,—and the structure of knowledge has grown progressively through the contributions which have been made in successive periods of time, influenced by the conditions of life which have constituted their environment. This, it may be said, has been eminently true in the development and growth of surgery—at one time the legitimate part of the barber's art, and emancipated only from this ignoble association when the genius of those who were its disciples gave to it its proper place as a part of the science of medicine, through the ingrafting of the principles of that science which were essential to its development and growth. In the successive ages of the World's history the value of life has been measured by the increase in knowledge of the means of its preservation, and all efforts have been directed to those ends, until in this day the prevention of disease, through the prevention of the causes which produce it, has become the ideal object of the labors of the disciples of the art of healing.

In view of the limit the writer has fixed for the discussion of the subject expressed in the rather comprehensive title of

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* Read by title before the American Surgical Association, June 4, 1909.

his paper, he is moved to state that it will concern chiefly his own experience, which covers nearly the last half of the last century. In that period of time two of the most important and controlling contributions to surgery have been made—the general introduction of the use of ether as a anæsthetic agent in major surgical operations and the method of antisepsis in the treatment of wounds.

With regard to the first, it has occurred to him to witness operations upon patients who had been placed in a state of insensibility, more or less complete, by large draughts of alcoholic stimulants or by the administration of opiates in unusual quantities. Firmly bound to the table the patient has been unable to offer successful resistance and the operative procedure was conducted to the end, despite the agonizing cries of pain and suffering. These conditions of necessity limited surgical interference to cases of absolute emergency and those which involved the extremities, as a rule, and which were the result of accidental injuries. Great as was this boon, general anæsthesia, to suffering humanity, the agent employed possessed certain objections, the chief one being that of the nausea following its use, in many cases, and the effort has been continuous to obtain a substitute freed from this condition. Up to this time many agents have been added to the list of anæsthetics, local and general; but attached to each there has been found to exist some element, either of danger or unsatisfactory efficiency, and the search, through observation, practical experience, and laboratory experimentation continues in order to find the ideal substance—one capable of producing complete insensibility to pain without the loss of consciousness. The nearest approach to the accomplishment of this desirable condition would seem to have been found in the use of stovine by lumbar puncture; but this method is not free from elements of danger, which, in reported cases, have led to fatal results.

Taking a fundamental part in the development and growth of surgery in the time set apart, were the methods of instruction in vogue in the beginning. The sessions of the medical

colleges were short; at most, not more than three and a half to four months in each year, and the student, while he was expected to enter at the beginning of the course, was permitted to begin his collegiate studies after a large part of the session had passed. A requirement for entrance and for the privilege of appearing for the examination for the degree of Doctor in Medicine at the termination of the two years' course of instruction, was a presumed year's study and apprenticeship in the office of a practitioner, whose qualifications as an instructor were quite an unknown quantity. No conditions were imposed as to preliminary education. Graduation from a school of high grade was rare, and still rarer was the possession of the degree of Bachelor of Arts by the candidate for admission. The methods of instruction were didactic, and the student sitting on the benches for two courses in succession heard the lectures of the first course repeated, without, in most instances, addition or emendation. When the learned professor read his lecture from manuscript pages, it has happened, to the knowledge of the writer, that the paper was yellow with age and the text was as ancient as the paper. The dissecting room was the only laboratory, and the work done therein was largely of a perfunctory and defective character, concluded without any test by examination in the presence of the dissected specimens, of the knowledge gained by the student. The fee for instruction paid by the student was outside of the college ticket and was the emolument of the demonstrator, and did not reduce the sometimes large receipts of the professors, who received all of the income of the college, paid the expenses of maintenance and divided the remaining balance, sometimes giving to each from five to eight thousand dollars in the year.

The large sum obtained by the professors each year was increased by the sale of the text-books, written by them, copies of which each student was expected to buy—if his financial resources permitted such expenditure. As the lectures of the professors were embodied in these books it was to the advantage of the student to possess them, and the study of them

assisted in the work of preparation for the final examination. In a way it may be said that the text-books on different medical subjects written by the professors who taught the branches, were more useful to the student than those written to-day by a number of authors and edited by one or two. As a student, in the text-book of the teacher he receives instruction which is individual, and not the opinions of many who may treat the subjects in very different ways. As a graduate and a practitioner the text-book of many authors may possess for him positive advantages and assist him in his work.

Anatomical material was expensive, and, in the absence of legal provisions by the State, sometimes difficult to obtain by methods short of " Burking," with the suspicion even that this method was resorted to. The surgical laboratory did not exist, and the student, as a rule, received his degree, which declared him qualified to practice surgery without having received any practical instruction in the application of surgical dressings or in the performance of surgical operations of either minor or major character upon the cadaver. The student who felt the necessity of possessing practical knowledge on this subject was compelled to obtain a cadaver at his own expense and pay a private instructor for the instruction given.

In the days spoken of, at a later period, the eminent teacher of surgery in Jefferson Medical College, Professor Samuel D. Gross, organized, as a part of the instruction of his chair, a surgical laboratory, and the writer was appointed to take charge of the department of surgical dressings, sharing the duties with a colleague who gave instruction in operative surgery. Later, the entire instruction in the laboratory came under the writer's care and the student received instruction in the laboratory, which was made compulsory, without extra fee. This condition the writer earnestly advocated, feeling that every student receiving the collegiate degree should be required to receive instruction of this character, and without extra cost. It is believed that the surgical laboratory, thus organized by Professor Gross, was the first established in the

medical colleges of this country. The branches of medicine which were included in the curriculum were the traditional seven, Anatomy, Physiology, Materia Medica and Chemistry, Principles and Practice of Medicine, Principles and Practice of Surgery, and Obstetrics. With the exception of anatomy the fundamental branches were taught only by lecture and laboratories, for experimental and practical work in these branches were absent. Students who were ambitious to gain practical knowledge in materia medica, had the opportunity in certain apothecary shops, where they were instructed in the art of making pills, powders and certain simple mixtures. In medicine, clinical instruction was given by the professors in turn, those occupying the chairs of anatomy and surgery giving clinical instruction in surgery in the divided halves of the term. Clinical material in medicine in the college clinics was limited entirely to walking cases illustrating chronic affections, as a rule of the stomach, not extending in nomenclature beyond dyspepsia or what was vaguely designated as chronic gastritis. The diagnosis, in each case, was most frequently, if not always, made without physical examination and based upon the very vague and non-intelligent information given by the patient. The treatment was eminently empirical: a condition of inflammation being assumed as the diagnosis, counter-irritation to the extent of blistering was advised, and enforced over the epigastric region, or, as more intelligently conveyed to the patient, over the pit of the stomach. When torpor of the liver was the suspected diagnosis, remedies which would administer a fillip to the lining membrane of the intestine were regarded as indicated in order to invite and stimulate hepatic activity. There were no obstetrical clinics as such. Gynæcology was taught by lectures, the use of the speculum was demonstrated upon models or the cadaver; physical examinations were not permitted to be made before the class by the teacher, and the members of the class were not permitted to make, even under the guidance of the instructor, in the clinical room, such examinations. The solid stick of silver nitrate, more commonly

designated lunar caustic, was the agent universally applied for morbid affections of the cervix uteri, and displacements were most frequently unsuccessfully relieved by the use of very varied and uncomfortable mechanical appliances. Believing that students in medicine should have practical instruction in the methods of making digital examinations, the writer at one time conducting the gynæcological clinic, arranged to give instruction in this branch in the retiring room of the clinic to the class, in sections. The instruction was prohibited by the controlling powers of the institution as not conforming to the rules, which protected the female non-paying patient from usage not agreeable to her sense of modesty. Instruction in practical obstetrics was obtained by students who felt its necessity, on the payment of a fee, in lying-in-homes. When sufficiently instructed in the institution they were permitted under the guidance of a practicing physician to take charge of cases in the homes of non-paying patients. At an earlier date somewhat, than that of which we write, the writer has been told that, in the then frontier West, the act of parturition was accomplished while the wife was held on the lap of the husband, a limb each confided to the care of sympathizing women neighbors, whilst the physician sat on a stool between the two. It can be readily understood that this position was not one of comfort to any who were required to take part in the procedure which, in the case of primiparæ was likely to be of a prolonged character.

Clinical surgery was taught in the college amphitheatre, and, as well as clinical medicine, in certain hospitals which had lecture rooms in the buildings. In the college amphitheatre the instruction was given by the professor of surgery, or, if a practicing surgeon, by the professor of anatomy. In some instances, one or two rooms in the college building not very remote from the odors and pathologic conditions of the dissecting room were assigned for the reception of patients who had been submitted to major operations in the clinic. Blood-letting for inflammatory affections was practiced and the writer, while on duty in the surgical clinic was directed by

the professor on one occasion to bleed a patient suffering from acute iritis. Inquiring as to the number of ounces which should be let, the answer was as follows: "Ounces! Bleed him, young man, until he falls over," and the orders were strictly obeyed, with the happy result of prompt relief of the phlogistic conditions. In the hospitals the students were not permitted to "walk the wards,"—the closest contact they had with the patients was from the benches of the amphitheatre, large enough, in some cases, to seat six hundred students.

Associated with the subject of the conduct of medical colleges, in the day of which we write, it is interesting to consider their method of organization. In some States the Legislatures granted charters to medical colleges which were parts of a sweeping franchise to construct a railroad and, possibly, one or two other enterprises of commercial character. These charters came into the possession usually of members of the medical profession with political proclivities, who sold them to other members of the profession ambitious to acquire the title of professors. Some of these colleges, thus organized, were undeniably fraudulent in character and conduct,— endowed, under the charter with colossal powers and privileges they conferred degrees of all kinds from A.B. and M.D. to LL.D. and D.C.L., in the majority of cases "in absentia," and for sums of money varying in amount according to the financial ability of the intending purchaser. The conferring of these degrees was not limited to this country, but extended quite over the World. In Great Britain and the continent of Europe the business became a subject of international interference, and happily, for the good repute of the medical profession of this country, it was stopped. In marked contrast the medical colleges of to-day, with possibly a few exceptions, can claim a greatly improved condition of excellence in the requirement for entrance, one, the Harvard Medical School, exacting the degree of Bachelor of Arts,—in the extension of the sessions,—expansion of the courses of instruction—organization and conduct of the laboratory systems, and all methods which contribute to the complete education of candidates seeking admission into the medical profession.

General hospitals, even in the larger cities of the country were few in number, limited to one or two at most. Among those most closely associated with clinical teaching and venerable in years of existence were the Massachusetts General Hospital in the city of Boston and the Pennsylvania Hospital in the city of Philadelphia, founded by William Penn. The clinical amphitheatre in this hospital was unique in character, having been constructed in what may be called the cupola of the main building, in a space so restricted that the students sat on benches almost overhanging in position, and looked quite directly down upon the teacher and patient.

In the days of which we write the operations performed in the clinics were usually in the form of amputations and the removal of external growths. Operations upon the cavities of the body were limited to the cranial, and did not pass beyond the use of the trephine in cases of depressed fracture. Paracentesis of the chest and abdominal cavities was performed for dropsical effusions. Thoracentesis, with rib resection, was not practiced, and although McDowell had opened the gateway into the abdominal cavity through his operation for the removal of ovarian tumors, this operation was rarely performed, and then not in the public clinics. The writer recalls an interesting experience which came to him on the occasion of a visit to one of the hospitals connected with the teaching in the University of Edinburgh, when a distinguished ovariotomist was required by the authorities of the University to perform the operation of ovariotomy in the public clinic. He protested that the conditions surrounding operations in a public clinic were hostile to any operation which involved the opening of the abdominal cavity. Yielding, however, to the official mandate, he did the operation, which fortunately happened to be of a very simple character, and when it was completed, remarked to the class of students: "Well, you didn't see anything, did you?" Cæsarean section had been performed in a few instances, and Dr. John S. Bobbs, of Indianapolis, Indiana, had performed the first operation of cholecystotomy.

In private practice surgical operations were performed in

the homes of the patients, in bed rooms and in living rooms, without any special preparations as to cleanliness. On one occasion, when the writer assisted in an operation of abdominal section—ovariotomy—the operating room was in the top story of a tenement house, under the roof, in a narrow alley-way. During the operative procedure a sudden and heavy thunderstorm occurred with a deluge of rain, and the water poured through openings in the ancient and perforated roof, one stream being so directed that, before the assistants could interfere, it entered the abdominal cavity through the large incision which had been made to effect removal of the adherent tumor. Efforts were made quickly to place the operating table, the usual kitchen table, in a place better protected from such irrigation methods. It was felt, however, by those present that the storm water was as clean, if not cleaner than that which was used from the somewhat battered and discolored tin hand-basin. The operating table in the homes was usually the kitchen or double-leafed dinner table, which were firmer than the bedstead or lounge which were sometimes brought into service. In one case, the writer excised the greater part of the upper jaw in a patient, who being addicted to the excessive use of alcoholic stimulants, became frenzied during the ether administration, and, flinging aside the assistants, men and women of the household, threw himself upon the floor. Extra help was summoned, which sitting upon the patient in his prostrate position, controlled him while the operation was completed—patient, surgeon, and assistants being well bespattered with blood. In another case in which the writer was called in consultation, the patient, a burly chief of police of the town and an alcoholic subject, during the process of ether inhalation sprang from the lounge in the stage of stimulation, went to a closet, and seizing a loaded revolver stalked about the room in a very menacing manner. The family physician, a brave and resourceful man, taking advantage of a convenient opportunity, leapt upon his back, pinioned his arms, and in this position directed his movements skillfully to the open door, the frightened assistants meanwhile emerging

from safe places of refuge which had been sought at the time of the impending danger. In this case, the operation was completed without the further administration of the anæsthetic agent.

Associated with these conditions of improvised operating arenas was the indifference manifested by the surgeon and his assistants with regard to the state of cleanliness of the operating instruments, of the sponges and other materials used in the wound-cleansing during the operation, and in the subsequent dressings which were applied. The instruments were not many in number, made with bone handles, white or black in color, often with dull cutting edge and kept either in an operating case or placed loosely in a bag of convenient size. The sponges, which were universally employed in the wound cleansing, were those gathered from the sea and found in the apothecary shops. Those known as surgical sponges were usually of finer texture than the ordinary bathing sponges. Frequently they were charged with calcareous particles and prickles that were almost microscopic which proved to be irritating to the wound surfaces as well as to the fingers. of the assistants using them. The sponges, if of good quality, were very enduring and did duty for a long period of time. One distinguished ovariotomist was accustomed to replenish his stock of *three* sponges at the beginning of each year. He never used more than that number, and they were always accounted for after an abdominal section, in order to prevent the untoward accident of permitting one to remain enclosed in the cavity when the operation had been completed, an accident which has happened in several recorded and some unrecorded cases. It is known to the writer that after operations the sponges have been used to remove blood from the table and even from the carpet or floor. They were cleansed after operations either in the basins which had been used to contain the hot and cold water, which alone was applied to the wounded surfaces, or under the hydrant in the back yard, if the patient lived in the home of the poorer class. They were placed uncovered in the bag containing the instruments in

which was also frequently concealed the morbid specimen which had been removed by operation. The basins containing the water used during the operation came either from the kitchen or bed-room, and the dressings and bandages were often obtained by tearing them from unlaundered sheets or muslin or linen underwear.

The garb of the surgeon was sometimes a rubber apron of large dimensions or a coat known as a generally used linen duster, on the sleeve or body of which the blood-clotted knife was frequently wiped. The assistants performed the duties assigned to them in their shirt sleeves divested of coat and vest. In the absence of proper conveniences the hands were not washed. In cases of malignant character or those accompanied by foul discharges they were anointed with olive oil or lard. The effort was constantly made to protect the surgeon and his assistants from dangers coming from the patient, not the patient from dangers coming from those taking part in the operation.

The writer has been told of an instance in which a very prominent ovariotomist of the middle West, who suffered from vesical calculus, accompanied by a severe cystitis, stopped twice during the performance of an operation, took the soft catheter from the place beneath the sweat-band of his hat, lubricated it with spittle, evacuated his bladder and continued the operation without washing his hands. Of another surgeon who, during an operation for amputation of the thigh, overheard the casual remark of one who was present that the patient looked as if he had " phthisis." He had made the anterior flap, but put the amputating knife upon the table and proceeded to make a physical examination of the patient's chest, one of his assistants holding his thumbs over the femoral artery with some anxiety during a somewhat prolonged procedure of auscultation and percussion.

The after care of patients in the hospitals was a duty undertaken, as a rule, by convalescent patients, or in some cases, by men and women who served as nurses for a slight compensation. As can be conceived, by these methods, patients

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suffered from ignorant and at times cruel treatment. The writer recalls an instance which happened during his term of service as interne in the hospital of a large eleemosynary institution, in which the nurses were taken from among the number of pauper inmates, some of whom belonged to the criminal class. On one occasion when a wound was being dressed, the nurse placed his foot, encased in a dirty boot, upon the bed, and spat tobacco juice from his foul mouth directly into the water contained in the dirty basin which was used in the effort at the supposed cleansing of the wound. This act was regarded as the limit of endurance, even in those nonaseptic days, and the offender was promptly relieved of his duties as nurse and sent to the kennels of the out-ward department. In the homes the care of patients after operation was assigned to the female members of the family or friends who volunteered their services. Under these conditions the patients received kind treatment and good care, sometimes endangered by the emotions which sprung from the warm heart of the attendant, whose conception of sick-room discipline was thereby influenced.

In no way was the absence of regard for cleanliness more forcibly illustrated than in the use of the catheter in hospital and in private practice. In the former the unwashed instrument was frequently used after lubrication with olive oil or simple ointment contained in vessels which had been in use for long periods of time, affording in this way easy access into the bladder of septic germs. In private practice the metal instrument carried in the pocket case, and lubricated in the home with lard or butter, was used. When the soft or rubber instrument was introduced the walking patient was instructed how to use it, and carried it conveniently coiled up beneath the sweat-band of his high hat, and when used in inconvenient places, lubricated it with spittle.

Of the dressings most frequently used after operations to combat inflammatory conditions the emollient poultice was most popular. It was made of stale bread crumbs with water or milk, but most generally of flax-seed meal. The directions

given by the learned professor with regard to the preparation of this last poultice were very specific in character, and unless these were strictly followed failure was predicted. The test given of the proper consistency was to be found in the adhesion of the mass to the side wall or ceiling of the room when projected against these parts of the room structure. At the final examination of the candidate for the degree given by the college, his ability to practice surgery was determined, to a certain extent, by his knowledge, in minute detail, of the poultice preparation. In the lectures and text-books poultices were classified according to the effect to be accomplished: as emollient, astringent, stimulating, fermenting, rubefacient, narcotic, etc. Suppuration in the wound followed the use of the emollient poultice and the discharge of pus was, as a rule, very copious. The wound condition was determined by the character of the pus,—if laudable, favorable; if sanguinolent or ichorous, unfavorable. Among other forms of dressings the writer recalls a case of amputation at the hip joint in which the stump was kept bathed with laudanum (tinctura opii) and without any manifestation of the toxic effect of the agent used.

During the Civil War the discipline which was enforced in the camp and on the march was carried, in some measure, into the management of the General Hospitals of the Service, with favorable results as to conditions of cleanliness in operation and in wound treatment. In this respect, however, the results were influenced to a large extent by the qualifications of the surgeon in charge, or of the inspector who made his tours of inspection. Notwithstanding the precautions taken and those which were born of the knowledge of the time, the mortality was very great. Gangrene, designated hospital gangrene, was of a most virulent type and resisted all known methods of prevention or treatment. The ignorance with regard to the influence of germ infection led to the tolerance of conditions most productive of disease dissemination, and thousands of lives paid the penalty for what was then regarded as a state of inevitable ignorance. The lessons, however, were

not lost, and the faithful, earnest surgeons of the day, grop-ing their way through the darkness sought the light which was to be reached in not many years to come. The General Hospitals were located in cities and, where possible, in the suburban parts, in the search for better air and surroundings. In some instances these were large wooden structures con-structed upon the pavilion system, which gave both light and air. They contained usually a large number of both medical and surgical cases, and the physicians and surgeons in at-tendance were largely chosen from those practicing in the cities, with some officers of the regular service. In the emergency, large buildings in the cities, which had been con-structed for factory or mill purposes, were taken and converted to hospital use. That these should fail to give the best results, by reason of former use and character of construction, was to be expected, but the needs of the Service demanded such provision for the sick and wounded, who in the large variety of diseases and wounds from which they suffered furnished a great school of instruction to the intelligent and observant physician. Chloroform, unmixed with other agents, was the anæsthetic largely, if not altogether, used in operation, and many lives, it was reported, were sacrificed through its care-less administration. The need of medical men in large num-bers to supply the demands of the Service led to the appoint-ment of many not fully qualified, but as a rule the surgeon, especially in the emergency of Service in the field hospital following great general engagements, was found to be equal to the duty imposed. The writer recalls two instances in which wounded soldiers were brought to a military hospital in which he was the temporary acting executive officer, with extremities suffering from compound fractures, the result of shell wounds; in one the limbs were encased in an excellent supporting dressing made from the · bark of a tree, and in the other, rails, taken from the ordinary rail fence of the country did good service in affording support and permitting comfortable transportation.

The large number of pathologic specimens obtained and

preserved, with full histories of each, laid the foundation for the valuable collection in the Army Medical Museum, the development of which, with the Surgeon-General's Library, was so successfully promoted through the work of our distinguished Honorary Fellow, John S. Billings, at one time the efficient surgeon in charge. In the ending days of the War the writer met in London, Sir James Ferguson, the celebrated English surgeon and teacher who remarked, in commenting upon the work done by the medical profession of our country in that heroic struggle, that the members had done splendid work and deserved great credit for what they had accomplished. No war, certainly none of modern times has offered such opportunities for the study of diseases and surgical conditions incidental to the life of the soldier in field and camp and in the deadly conflict of arms. The arm of precision today projects a missile the purpose of which is to disable, to put the soldier out of service—in the time of which we write its duty was to destroy life, discharging, as it did, the large death-dealing minie ball. Following the experience gained in the Civil War, surgical endeavor was greatly stimulated and methods were improved. In this period also, and later, there appeared operations which may be designated, as in a way, fashionable. The organs of generation in the female and near-by parts presented a large field for exploitation, and operations were performed for the relief of supposed functional disturbances, correlated with supposed grave constitutional conditions. Freed from the difficulties and dangers of organic changes the hand of the tyro and empiric found free play. Condemned by professional opinion and judgment these operations have been stricken from the list of those necessary to be performed, or justifiable in purpose. Unfortunately for the good repute of surgical science, this glamour of professional notoriety, promoted by the eager desire of commercial success, has been in a measure transmitted, even to this day, and confiding patients have been, shall we say, the victims of the untoward results of surgical procedure not necessary for the relief of supposed morbid

conditions. But this is passing,—the stern verdict which true science renders when sitting in judgment on the work of those who assume to be its disciples, consigns to merited punishment those who violate its principles and degrade the standard of its code of ethics.

The operations, claiming in these days to be the most important, and involving as well danger by reason of their character and magnitude, were amputations at the hip joint, ligature of large arterial trunks, and the removal of ovarian tumors by abdominal section. In the former operation the percentages of success were fairly good. The text-books of the day gave prominent position to a surgeon of local repute who had three successful cases—in succession. A mortality not exceeding 32 per cent. was regarded as most favorable in operations of ovariotomy,—and this percentage prevailed when the cases were those of non-adherent monocysts. In multi-locular cysts with parietal and visceral adhesions, the percentage of mortality was greatly increased, exceeding often 50 per cent. The writer, as the assistant of the distinguished ovariotomist, Dr. Washington L. Atlee, contributed a chapter on the " Pathology of Ovarian Tumors " to his book, and in this he announced what he regarded as a discovery of some interest, to the effect that the pathological conditions which followed operative interference had an important relation to the length of the incision made in the linea alba in the abdominal section. The small incision was only possible in simple monocysts in which, when the fluid contents were being drawn off, the flexible walls of the cyst could be drawn into the opening, and effectually sealed the abdominal cavity, thus preventing the ingress of the air, and with it the then unknown and unrecognized myriads of organisms with which it was charged. The knowledge of the day did not permit of an understanding of the relation of cause and effect involved in these conditions. Experience had demonstrated that the air in coming in contact with the surfaces of a wound the lining membrane of a closed or serous cavity, was ful, but in what manner it acted was not known. It re-

mained for Lord Lister to solve the problem and to devise a system through which these organisms were destroyed and the process of putrefaction in wounds prevented.

In the decade included between the years 1865–1875, the dawn of a new era appeared in surgery: the beginning of the new—the new built upon the work of the old, surcharged as it was, of very necessity, with ignorance born of the absence of knowledge beyond the discern of man. The wound conditions with which the observant surgeon had to deal led in time to the recognition of the fact that they were not normal, that there were no conditions in the tissues themselves which should generate them, and that their causes must be sought for outside. The experimental researches of Pasteur determined the causes of putrefaction, and it remained for the reflective mind of Lister to associate these causes with the abnormal conditions observed in wounds. The result of his painstaking and laborious effort was the creation of a system which prevented the introduction of putrefactive influences into wounds, the destruction of the organisms of putrefaction, everywhere existent, before or after their admittance into a wound cavity. This was the beginning of antiseptic surgery, a monumental contribution to the science of which Lister was an illustrious disciple and one which has influenced its development as no other which has ever been made. In the gradual process of refinement from the crude but efficient antagonistic measures and combative dressings to the perfected system of to-day, antiseptic surgery has been deposed, and aseptic surgery rules in its stead. The foul kitchen basin has given place to the porcelain lined tray,—the sea-born sponge, with its myriad cells charged with deadly organisms, has been replaced by the cleanly, once-used gauze sponge,—the bone and wooden handled knife by the one-piece metal instrument—the kitchen table and sitting-room lounge by the metal and glass structure with its convenient mechanism. The bed-room and sitting-room in the home, and the amphitheatre in the college with its revolving table, used alike for the dissected cadaver and the patient undergoing surgical operation, has been displaced

by the microbe-proof operating arena with sterilizing apparatus, glass cases for the deposit and care of instruments, perfect ventilation and lighting. The operating surgeon in his linen duster with his assistants in shirt sleeves have been banished, and in their places are the surgeon, assistants and nurses enrobed in white, with masks, hands thoroughly scrubbed and rubber-gloved, with trimmed finger nails freed from microbe accumulations. The unbathed patient, in possibly street-walking garments, gives place to the scrupulously bathed and appropriately robed patient, with operating field cleansed with microbe destroying agents. Thus equipped, the surgeon enters any cavity of the body with impunity and attacks with expected assurance of success morbid conditions involving organs and parts heretofore beyond his power to assault—safe through his ignorance.

In our country, antiseptic surgery was to a certain extent a plant of slow growth. Learned teachers of surgery in our colleges, some too old to accept readily new things, some too young to appreciate its far-reaching importance and grasp its power, and still others doubtful as to its true value, referred to it as something new and to be proven. It happened at the introduction of the system of Sir Joseph Lister that the writer was one of the corps of lecturers in the Summer School of Jefferson Medical College. The subject he taught was practical operative surgery, and he endeavored, to the best of his ability, in his course of instruction, to teach the principles of this great system. In his hospital practice in St. Mary's Hospital, Philadelphia, in association with his colleague, Dr. W. W. Keen, he practiced antiseptic methods of treatment, employing the crude carbolic oil- putty as a surgical dressing. It is believed that this practice of the antiseptic methods of treatment by Dr. Keen and the writer was the first carried out in the city of Philadelphia. Despite the warning sent to the writer by the learned professor that he must cease teaching the so-called new fangled and harmful system, he continued to teach the subject, and was greatly gratified to know within a year's time, that the messenger who had con-

veyed the injunction issued, was as enthusiastic and earnest an advocate of the system, both in his lectures and practice, as the writer.

Such is a simple description of the old and the beginning of the new in surgery, as experienced by the writer in the period of time set apart. He has endeavored to place on record events which have come under his own observation and which show not only the conditions which then were in existence and with which the surgeons of the day wrestled heroically, but those which exalt to the pinnacle of successful endeavor the achievements of to-day. In the ranks of the practitioners of surgery in those days there were stalwarts, men of resource, men of courageous convictions. With the facilities then possessed it was indeed a battle to win success against an enemy ever present, but unknown and concealed.

To-day the patient requiring surgical treatment, enters the hospital, private or public, constructed upon methods the most modern, and with full equipment for perfected work; from the door of entrance he passes from department to department, submitted in each to critical examination, and finally reclines upon the operating table, a transparent body into and through which the eye of science has penetrated, revealing the hidden morbid conditions, the significance of which the trained intellect of the expert has fathomed. At the operating table stands the surgeon with complete record in brain and knife in hand, to prove its accuracy and reveal it to the naked eye. With deft touch he excises morbid masses, shapes and fashions parts, reconstructs organs and restores halted function. Thus reconstructed, the patient emerges from the modern hospital a faultless specimen, illustrating the high art of the master hand.

And what is the future of surgery in the coming half century? Has the climax of surgical technic been reached? Is the earnest worker in surgical science satisfied with the present state of diagnostic precision? Is there not a large and inviting field for pathologic research? The work in this direction has already begun, and in the list of our Fellows

there are able and zealous workers laboring to unravel the entangled problem of the abnormal, the abortive cell,—to devise the means of retarding the action and checking the growth of the over stimulated cell,—to so control cell development and cell growth that homologous and heterologous formations will have no lodgment in the tissues and organs of the body—to formulate, may we not say, the proposition of preventive disorders which find their relief, too often unsuccessful, in the knife of the surgeon? Will organ substitution, the replacement of a diseased organ by one in every respect in a state of health, find a legitimate and established position in surgical art? Will the operative surgeon enlarge his sphere of action and become as well the constructive surgeon, doing the combined work of architect and builder? Are these the fantastic images of a prophetic vision? The history of the development and growth of surgery in the past gives reality to our expectations and hopes of what the future may unfold, and is this, in truth, not the great work of the surgery of the future?

SUDDEN DEATH: A STUDY OF CERTAIN CASES OCCURRING DURING PHYSICAL EXERCISE OR PSYCHIC SHOCK.*

BY JOHN BAPST BLAKE, M.D.,

OF BOSTON, MASS.

Instructor in Surgery in Harvard University; Assistant Surgeon to the Boston City Hospital·

ABOUT two years ago, a gentleman apparently in superb health, well known and much beloved in Boston, dropped dead while playing hand-ball. This event and the subsequent autopsy, both of which will be later described, brought vividly to the writer's attention the subject of unexpected sudden deaths, and this brief paper is a summary of observations made since that time. The first question involved was whether it is possible for a practitioner to foretell such a calamity in an individual patient, and if so to prevent or at least postpone it; the second inquiry seeks to determine whether the meagre information obtained can be utilized by the surgeon. The obvious difficulties surrounding the subject make it impossible to offer a final decision, based on a sufficient number of facts scientifically observed, in relation to either of these questions; but certain suggestive and frequently recurring features seem worthy of consideration.

Definition.—For the purpose of this paper, sudden death is defined as a phenomenon unforeseen, due neither to trauma nor to poison, whose duration is measured by minutes, and whose subjects in a vast majority of instances are supposed to be free from organic life-threatening disease.

Frequency.—Within the past two years the writer has collected from the medical and lay press, from medical examiners, and from other sources statistics of more than two hundred sudden deaths. This number represents by no means an exhaustive or thorough search for these fatalities, and is probably not more than one-half the total number which

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* Read before the American Surgical Association, June 5, 1909.

actually occurred during this period in the northeastern section of the United States.

A small proportion of these notes include autopsy records and a somewhat larger number are accompanied by personal interviews with, or letters from parents, relations, friends, or eye-witnesses. The ideal record of a sudden death would include an accurate and complete previous history (and if possible a physical examination), and an autopsy made by a competent pathologist. Unfortunately, both of these sources of information are absent in a large majority of cases, and when one is available, the other is almost certain to be missing.

The records of medical examiners or coroners' physicians should be and are numerically our chief sources of information; but even these usually lack a thorough previous history, and an autopsy is permissive only in cases which are non-traumatic. In fact when sudden death seems, in the judgment of the examiner, due to "natural causes," an autopsy need never be made; and this is the precise class in which we are most interested, and the sources from which we could learn most are thus unfortunately greatly limited at the very fountain head. In spite of this, however, the figures are sufficiently large to be impressive.

Draper ("A Text Book of Legal Medicine," 1907) gives the following figures for sudden deaths due to "natural causes":

STATISTICS OF MEDICAL EXAMINERS.

FERRARIO and SERMOINE of Milan observed...... 1043 cases
WESTCOTT, coroner for Middlesex district, London,
in 1000 consecutive deaths which were the
subject of inquest, saw due to "natural
causes" .... 303 cases
DRAPER himself, from 1877 to 1903, saw........ 1850 cases
(of which 475 came to autopsy).
BROUARDEL ("Death and Sudden Death,") refers
to .... 1000 cases
and says that "the two groups of infanticide
and sudden death together constitute two-
thirds of the medicolegal autopsies made in
France annually."
The writer has collected, apart from the above,
notes upon .... 225 cases
Total .... 4421 cases

No further argument is needed to demonstrate the fact that these unfortunate incidents occur with rather surprising frequency.

Causes.—Draper enumerates thirty-three causes, many of which might be subdivided into several distinct conditions; Brouardel gives no less than seventy causes. Among these, however, are many which would be eliminated for practical purposes in deaths limited to the class considered in this paper; such are pneumonia, Bright's disease, alcoholism, cerebral hemorrhage, peritonitis, meningitis, pericarditis and similar diseases. It is true that these may at times be ended by a sudden death, but it is only infrequently " unforeseen " and seldom within our accepted definition of time. Even cerebral hemorrhage is in the very great majority of cases a cause of death measured by hours rather than minutes (Loomis, Draper), the rare exception being when the medulla is the site of the lesion.

Within the definition of this paper the common causes of sudden non-traumatic unexpected death are: status lymphaticus, myocarditis, arteriosclerosis (particularly of the coronaries), thrombosis and embolism (particularly pulmonary), hemorrhage (aneurism, pancreas), acute dilatation of heart, rupture of heart, alcoholism, valvular heart lesions.

To these must be added, as exciting causes or conditions: severe or unusual exertion, moderate exercise, fright or intense emotion.

Age.—Sudden death is more frequent after the age of 40 than before, and much more frequent after 55 years. Yet the number under 30 is considerable, and youth and even childhood is not entirely exempt. Percentages are difficult to obtain, but it is probably well within the truth to say that less than one-quarter of the sudden deaths occur before the age of 40.

Conditions Present.—It has been already noted that autopsies in these cases are all too infrequent, and that complete previous histories are almost unknown; in addition to this, it is a fact that a certain percentage of deaths occur in which

even an autopsy fails to discover the cause. Brouardel places this percentage at 8 to 10. It becomes therefore all the more important to study the *conditions* under which sudden death occurs, and which seem to be its immediate exciting cause; if we find certain conditions preceding death with considerable regularity and constancy, it is fair to infer that these conditions play an etiological rôle, and should therefore be studiously avoided, or if this be beyond our power, should be diminished indefinitely towards the vanishing point.

In the 225 cases collected by the writer, these conditions have been noted with some approach to accuracy. They may be roughly classed in four groups: (*a*) severe or unusual exertion; (*b*) moderate exercise, or habitual non-laborious occupation; (*c*) quiet, rest, sleep; (*d*) fright, surprise, intense emotion, psychic shock.

These again are of necessity relative terms, since severe exertion for one might be moderate exercise for another; but if translated always in reference to a given individual, they become as definite and arbitrary as any we can hope to obtain. The essential point to be considered in each case is whether the condition is something usual or unusual for the individual, something to which he is or is not accustomed. Beyond this, however, there are certain other qualifications; some exercises are always severe, no matter who may undertake them; such are racing, high mountain climbing, struggles with men or beasts. Indeed, simpler forms of exercise may at one time be severe, at another distinctly moderate: for instance, in one case a drummer marching with his band falls dead while beating his drum; if this were a hot day after a very long march, it should be classed as excessive; if it were at the beginning of duty it might fairly be called moderate.

In examining these 225 cases, it became evident that a very small percentage of deaths occurred either during or immediately following extremely severe exertion; this seemed at first paradoxical until it became evident that in very many persons predisposing to sudden death, extreme exertion, The y of a sort often repeated, would be impossible; this

is particularly true of school and college athletics, and apparently explains the infrequency of non-traumatic sudden deaths in athletics throughout this country in spite of the enormous number of boys and men who indulge in strenuous sports.

Applying this classification to these 225 cases, the exciting cause or condition seems to be: (a) severe or unusual exertion in one-fifth; (b) moderate exertion in about one-fourth; (c) deep emotion or psychic shock in a little less than one-fifth. The remaining cases, about one-third of all, occurred during conditions of rest or sleep.

In reviewing the 225 cases, the chief difficulty has been in the choice of illustrations, as the number is almost indefinite.

CASES ILLUSTRATING SEVERE OR UNUSUAL EXERTION.

CASE I.—A gentleman of 50, of excellent habits, strong and athletic and a powerful swimmer, was playing hand-ball with a friend; just after a rally, he dropped to the ground and died immediately, without struggle or outcry. An autopsy showed arteriosclerosis and myocarditis, cardiac hypertrophy but no dilatation; the pathologist stated that this condition might well have been impossible to detect ante mortem, even by an expert. This gentleman was accustomed to take long swims in the ocean, to climb mountains, to play hand-ball, and was the last man that would be associated in the minds of his friends with organic disease. It later appeared that he had been seen to turn pale under severe exertion, and that on one or two occasions he spoke of a sense of oppression across the chest. It would seem, therefore, that the closest attention must be paid to the history of such experiences, as well as to auscultation and percussion, if in the future we are to detect cases whose essential lesions are myocardial or arteriosclerotic.

CASE II.—A powerful farmer was attacked by a mad bull; he defended himself by great exertion for nearly an hour, holding on to the bull's horns, and being violently thrown and tossed around. He was finally released, walked a short distance to his home, and fell dead at the door.

CASE III.—In 1877, Renforth, a celebrated oarsman, fell over during a fiercely contested four-oared race, at St. John, N. B. He was removed from the boat, and died in a short time. Autopsy showed a hypertrophied but otherwise normal heart and an intense engorgement of the lungs, which did not collapse on exposure to the air.

CASE IV.—Within the past year, two young men have died either during or immediately following a Marathon race.

CASE V.—A school-boy, 16 years old, was competing against a rival school in track games. He had already raced four or five times, and entered the quarter-mile run, which was bitterly contested. At the finish

he staggered and fell, and died immediately; his face was cyanotic and pupils widely dilated; the examiner did not make an autopsy, but called the condition "overstrain of heart."

It is an interesting fact that in a considerable number of cases in which cardiac disease is either recognized, or strongly suspected, the individual successfully withstands severe exertion, only to succumb, at a later period, to exercise more moderate.

A young college student, whose physical condition was supposed to be satisfactory, was a candidate for the football team; one day, before the regular practice, he ran a few steps and kicked the ball, returned to the sidelines, and fell dead. It was later discovered that his brother had died suddenly a few years before, and that this young man had been warned to beware of severe exercise; he had indulged in such exercise with but slight moderation, and had never experienced distress; but he died after an amount of exertion which was distinctly trivial.

A step beyond this is illustrated by a young man known to have a severe mitral incompetence, and prohibited by his doctor from taking part in any severe sport. In spite of the warning, he played both baseball and football; his friends testified at a later date that they had often seen him seriously distressed in both games; pale, very short of breath, and obviously exhausted beyond the condition of the average boy. He graduated from active sports and entered business. One morning, after breakfast, while in apparently excellent condition, he stopped for a moment to light a cigar while walking to catch a train; he was going up a very moderate incline, and was seen to fall; he died in a few minutes, without a sound or a struggle. This would seem to show that the excitement and nervous exaltation accompanying severe competitive athletics have a stimulating effect upon a damaged heart, and at times prevent it from stopping under a strain far greater than that to which, at a later period, it finally succumbs.

CASES ILLUSTRATING DEATH DURING MODERATE EXERCISE.

A man in apparent good health is mowing his lawn and drops dead.

A man who has not missed a day's work in twenty-one years drops dead while driving through the gate of the mill at which he was employed.

Another drops dead while shaving.

. A milkman, delivering milk, falls dead at the door of a customer's house.

A man playing golf dies while hunting for a lost ball.

A farmer apparently in the best of health drops dead while driving his cattle home.

In all these cases the exertion is very moderate, and has been a habit for years.

Cases Illustrating Psychic Shock.—These cases are also numerous and interesting. Stephen Douglas, the son of the great rival of Lincoln, died suddenly; a few hours before, on its fiftieth anniversary, he had delivered a speech on the exact site where his father had contested the great issues with Lincoln.

A large number of deaths occur during speech-making: a noted temperance orator, in appealing to a youthful audience, came to the front of the platform and said with great earnestness: "Young men, take care of your records," and fell dead.

An old soldier, speaking at a reunion of a dead comrade whose vacant chair stood near him, became greatly affected and said, "But in the end the vacant chair always conquers," and fell dead beside it.

A Rabbi praying, a minister preaching, a penitent listening to a lecture on death, die without warning.

An apparently healthy boy runs to see a fire engine; just as he reaches the door of the fire house, the engine unexpectedly dashes out directly at him, but without touching him. He dies immediately, and autopsy shows status lymphaticus.

A sturdy farmer sees his son cut to pieces in a mowing machine, and falls dead; his son recovers.

A young woman sees her uncle step from a train and fall dead, and she falls dead beside him.

Such cases, always dramatic, could be enumerated almost indefinitely, to emphasize the fact that emotion is very often a potent factor in originating the processes which result in sudden death.

It is obvious, therefore, that emotion, exercise, and exertion are very frequently the exciting cause of sudden death. And a moment's consideration reveals the fact that these are precisely the conditions preceding and accompanying the average surgical operation. The apprehension and fright are very obvious, while the effect of the anæsthetic upon pulse, respiration, skin, and kidneys is precisely that of moderate exercise; furthermore, the effects of long-continued and very serious surgical interference are again precisely analogous to very severe exertion. We have, therefore, in the routine of modern surgery, reproduced with considerable accuracy the precise conditions under which a majority of sudden deaths occur. Is it not a fair inference that many of the all too fre-

quent deaths said to be due to anæsthesia, are simply coinci-
dental, and would have occurred with equal certainty under
any other procedure which reproduced these precise conditions?

Sudden deaths before, during, or immediately following
operation are too common, and undoubtedly many occur that
are not reported. The writer has been informed of six in the
past year in which with perhaps one exception neither the
anæsthetic nor the operation seemed a sufficient cause. It is
notorious to those who concern themselves with anæsthesia,
that ether and chloroform are frequently blamed for catas-
trophies for which they are not wholly, or at times even in
part, responsible.

The more we know of the real nature of these deaths, the
better shall we be able to avoid them. Certain facts stand
forth. We cannot yet predict with any certainty the individ-
uals who are doomed to sudden death, nor the time of its
occurrence, but we do know many of the pathological condi-
tions which predispose to it, and the circumstances under which
it most frequently occurs. In endeavoring to guard against it
we must remember:

1. The comparative frequency of status lymphaticus. At
least eight cases have come to medicolegal autopsy as the result
of sudden death in Boston within the past year, and in the
experience of only two medical examiners. Another has been
withheld from operation by the skilful diagnosis of a physician;
another died shortly after a simple circumcision. It is be-
lieved that the diagnosis can often be made in advance by
attention to the possible presence of a thymus, bowing of the
femurs, a thick, short neck, and, in men, pubic hair of the
female type. Of the eight cases upon which autopsy was done
six died almost instantly, and two some hours after a slight
injury was received.

2. The invariable necessity for a more thorough and
complete physical examination and personal history before
operations even of a minor character.

3. The importance of diminishing to a minimum pre-
anæsthetic fright, apprehension, and intense emotion, for the

sake of the patient's safety as well as comfort. (Dr. Crile has reported an admirable method of doing this in thyroid cases.)

4. The very great importance of complete histories and autopsies in every case of sudden death, an end which can be best attained by securing the active co-operation of medical examiners and coroners' physicians.

5. The necessity of the careful report of every case of operative sudden death, even if no autopsy is obtained, by the surgeon in charge of the case. It does not seem essential that such reports should be originally presented to the world at large, but they might well be made to a small committee of this Society and by them examined and analyzed, and the essential facts brought to the attention of the medical public.

Dr. Blake would greatly appreciate any notes of sudden deaths of the character above described, which have occurred under the observation of the members of the Society.

THE TREATMENT OF TETANUS BY CHLORETONE.*

BY WILLARD HUTCHINGS, M.D.,

OF DETROIT, MICH.

THE indications presented by a case of tetanus are: First, to remove the source of toxin supply. This can be accomplished by thorough local disinfection or by amputation. Secondly, to neutralize the toxin present in the circulation which has not yet combined with the nerve cells. This is done very well by the injection of sufficient quantities of antitoxin. And this is all antitoxin will do. There are no theoretical grounds for belief and no clinical evidence to show that it affects, in any way, either the growth of the germ or the nerve cell-toxin combination. Thirdly, to keep the patient alive until the body can overcome the effects of the toxin which has already entered into combination. Death in a vast majority of cases results from one of two causes. Either the amount of toxin is so large or so active that it directly affects a weak heart or the vital centres in the medulla, the patient dying in a few hours; or death results from exhaustion following the prolonged and severe muscular contractions. Practically all the former class will die. It is in the latter class, those which die from exhaustion, that treatment is more hopeful.

The object here is to control the muscular contractions, for it is as the result of these, directly or indirectly, that the patient dies. Directly, a prolonged severe convulsion may prevent air entering the lungs, the patient dying of asphyxia. Indirectly, prolonged violent muscular action produces greatly increased amounts of poisonous katabolic products which must be eliminated. At the same time, elimination by the lungs, the intestines and the kidneys is interfered with. Together with this, it is also frequently impossible to give sufficient nourishment. This unfortunate combination soon leads to a

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fatal issue. Provided the muscular manifestations can be controlled, we can prevent the increased katabolism, aid the eliminating organs to free the body of toxin and give sufficient food to maintain the strength of the patient. To this end a number of agents have been recommended. Some time ago, in conjunction with Dr. Charles T. McClintock, I began a comparative experimental study of the various methods of treatment which have won a recognized place in tetanus therapy. As the result of these experiments, we became convinced that chloretone was the best substance which had thus far been employed for the purpose of controlling the muscular manifestations of the disease. I have had the opportunity of treating six cases of tetanus which have been referred to me by this method with five recoveries. Of these, one was mild; one moderate; three severe and one fulminating. They are as follows:

CASE I.—Hungarian, 26 years old. Admitted to St. Mary's Hospital December 13, 1907. Seven days before admission, six before the appearance symptoms, he crushed the distal phalanx of the middle finger of the left hand with a hammer. It was washed with water and wrapped in a clean cloth. He did not consult a surgeon and no further dressing was attempted. On the morning of the 13th he complained of stiffness in neck, inability to open his mouth and pain in his back. This condition became worse during the day and that evening he was removed to the hospital. He was given 1500 units of antitetanic serum every twenty-four hours together with large doses of morphine, chloral, and bromides. Despite this treatment, he became worse. I first saw him at 7 P.M., December 17. At this time he was in marked tetanus. Clonic convulsions were frequent and severe, opisthotonos being marked. He could separate the teeth ½ cm. and could swallow. Thirty grains of chloretone dissolved in one-half ounce of whiskey were given per mouth at 8 P.M. At 8.15 he was sleeping naturally with all his muscles completely relaxed. The jaws could be opened to their fullest extent. Vigorous palpation, loud talking, and the flashing of an electric light in his eyes caused no response. He remained sleeping quietly until 1 A.M. of the eighteenth, when he awoke. The previous

symptoms returned but were not so severe. Twenty grains of chloretone in whiskey were at once given. This kept him quiet most of the time until 1 P.M. He could now swallow freely, and took nourishment readily. He had no return of the clonic contractions. From this time the tonic contractions gradually lessened. He was able to open his jaws freely on the twenty-second and on the morning of the twenty-third ate dry toast, chewing it well. The finger was amputated on the eighteenth. He received 1500 units of serum and 30 grains of chloretone daily until the twenty-second, when they were discontinued. At 4 P.M. of the twenty-third, the patient complained of severe pain in the abdomen, and the temperature, which had been normal since the nineteenth, went to 103 with pulse of 140. He became rapidly worse and died at 6 o'clock the morning of the twenty-fourth. During this time there were no symptoms of tetanus.

Autopsy showed a perforation of the colon near the splenic flexure, and general peritonitis. Cultures from the peritoneal exudate and heart blood showed a streptococcus. This patient had recovered from tetanus and all treatment had been suspended. He undoubtedly died as a result of the peritonitis. Cultures from finger were negative for tetanus.

CASE II.—Female, unmarried, 23 years old. Had an abortion performed May 11, 1908, at 3 P.M. Did well until May 17 at 6 P.M., when she noticed that she moved the jaws with difficulty. This became worse, and on the eighteenth she could take no solid food, and swallowed fluids with difficulty. Her condition became worse on the nineteenth, when she had her first clonic convulsion. These increased in frequency and severity until the twenty-second, when she was removed to St. Mary's Hospital. I first saw the patient at 10 A.M., May 22. At this time she showed well-marked tetanus. The muscles of the entire trunk were in tonic contraction—limbs not affected, head drawn back, muscles of mastication rigid; could open mouth ½ cm., and was unable to approximate chin to sternum. Clonic convulsions were frequent and severe. An attempt to examine the patient's abdomen caused a violent convulsion lasting one minute. She was at once taken to the operating room and curetted under chloroform. An emulsion of these curettings injected into 350 Grams guinea pigs caused death from tetanus in six days. While under the anæsthetic, a stomach tube was passed and 30 grains of chloretone

dissolved in whiskey given. This was almost immediately re-
gurgitated. Two thousand units of the antitetanic serum were
given subcutaneously, and 2000 intravenously. On recover-
ing from the anæsthetic, she was unable to swallow, and all
previous symptoms returned. Thirty grains of chloretone dis-
solved in hot olive oil were given per rectum and retained. One
hour later, the patient was sleeping quietly, all muscles were com-
pletely relaxed while the mouth could be opened to its fullest
extent. She remained in this condition until the following morn-
ing, when there was some rigidity of the abdominal and neck
muscles. She could open the jaws about 1½ cm., and took nour-
ishment readily. An attempt to test the patellar reflex caused
several slight convulsions. The dose of chloretone was repeated.
Within 30 minutes she was sleeping quietly, completely relaxed.
From this time she made an uninterrupted recovery. The chlore-
tone was repeated every 48 hours until May 30, when it was
discontinued. Three thousand units of antitetanic serum were
given daily subcutaneously. During this time she took fluids
readily. Four litres of saline solution were given per rectum
every 24 hours. Large quantities of urine were voided volun-
tarily and the bowels were moved freely by large doses of cascara.
She was discharged June 8, cured.

CASE III.—Was a moderately severe one following a blank
cartridge wound of the hand. The incubation period was 10
days. This case yielded perfectly to treatment as outlined above
and was discharged cured.

CASE IV.—Pole, male, 24 years. Was admitted to Harper
Hospital May 28, 1908, for a severe crushing injury to left hand
sustained in manipulating a bread-mixing machine. The soft
parts, particularly on the palmar surface, were badly lacerated.
No bones were broken. After disinfection with soap, alcohol,
and bichloride, the bleeding vessels were ligated with catgut, and
the parts approximated with catgut and silkworm sutures. Infec-
tion followed, and a large portion of the flaps sloughed. On
June 15, the necrosed integument and portion of three fingers
were removed. At the same time, a skin flap from the abdomen
was sutured to the dorsal surface of the hand, the arm being re-
tained in position by bandages. On June 22 this flap was removed
from its attachment. On June 29 a similar flap was applied to
the palmar surface of the hand, and on July 6 this was removed

and the abdominal wounds sutured with catgut. The patient did well until July 15, when he complained of stiffness of his jaws and pain in his back and neck. He became worse despite large doses of morphine and bromides and 1500 units of serum. I saw the patient at 9.30 A.M., July 19. At this time he was in severe tetanus: unable to separate the jaws or swallow. Seventy-five grains of chloretone were given in olive oil per rectum. The wounds were curetted and washed with hydrogen peroxide. Cultures from these were negative for tetanus bacilli. Forty-five hundred units of serum were given intravenously. At 3 P.M. he could separate the jaws 2 cm. and swallow freely. From this time forward he had occasional clonic convulsions until July 26, when they ceased. The tonic contractions disappeared gradually, being completely absent on the twenty-seventh. Sixty grains of chloretone were given on the twentieth and twenty-third, and 30 grains on the twenty-sixth. Fifteen hundred units of serum were given subcutaneously daily until July 28, and elimination forced as much as possible. He was discharged cured August 4.

CASE V.—This was a mild case following an extraperitoneal shortening of the round ligaments. The incubation period was 12 days. She yielded readily to treatment, making an uninterrupted recovery.

CASE VI.—American, 52 years old, chronic alcoholic. On January 25, 1909, patient fell from scaffolding, sustaining an open fracture of the right arm at the elbow. This was reduced by Dr. T. A. McGraw, at St. Mary's Hospital, at 11 A.M. The case pursued an uneventful course until the evening of January 29, four days later, when he complained of severe pain in his fractured arm and in back. At 10.30 there was some rigidity of the jaws and difficulty in swallowing. During the night he received one grain of morphine and slept at intervals, complaining of pain when awake. At 7 A.M. January 30, he had severe clonic convulsions. I saw the patient at 9.30. He was sitting up in bed in a state of marked emprosthotonos. His clothing was soaked in perspiration. The muscles of the entire body except the arms were in a state of marked tonic contraction. He was unable to separate the jaws in the slightest degree or to swallow. *Risus sardonicus* was pronounced. During the five minutes of observation, he had eight severe convulsions. Seventy-five grains of chloretone in two ounces of hot olive oil were given at once per

rectum, and retained. Under light chloroform anæsthesia, the wound was opened by Dr. McGraw, thoroughly curetted, washed with hydrogen peroxide and packed with gauze saturated with balsam Peru. He was returned from the operating room at 11 A.M. At 11.30 he was sleeping quietly, all the muscles relaxed, the jaws being widely separated. Patellar reflex very slight. Vigorous palpation of the abdomen caused three slight clonic contractions. At 12 o'clock, cultures were made from blood taken from the left median basilic, with the idea of determining the presence of the tetanus bacillus. Unfortunately the cultures were broken on the way to the incubator. However, two 350-Gram guinea pigs were inoculated, one with two c.c., the other with one c.c. of the blood from the same source. Both pigs showed well-marked tetanus at the end of 24 hours, and were dead at the end of 60 hours. Cultures from the wound were positive for tetanus bacillus. Forty-five hundred units of the antitetanic serum were given subcutaneously near the brachial plexus. The patient awoke at 1 P.M. and complained of pain in his arm. At this time there were no tonic contractions. He could open his mouth one inch and swallow with little difficulty. He had occasional slight tonic contractions during the afternoon, and at 3.30 received 50 grains of chloretone in one ounce of olive oil per rectum. He remained quiet until 10.15 P.M., when he began to have severe clonic convulsions. Fifty grains of chloretone in olive oil per rectum was almost immediately expelled. On account of the frequency and severity of the convulsions, he was anæsthetized and 50 grains of chloretone in 1 ounce of whiskey given per stomach tube. The effect was almost immediate. At 11 P.M. he was sleeping quietly, completely relaxed. He remained in this condition until 3 A.M. of the 31st, when pulse began to fall. At 9 A.M. the pulse was 170–180 and thready. At the same time, the respirations were 30, full and regular. Notwithstanding the administration of large quantities of saline by hypodermatoclysis and oxygen, the heart became gradually weaker. The pulse was imperceptible at 10.45 A.M. The respirations remained good until the pulse stopped, when they gradually became weaker and he died at 11.10, completely relaxed. Postmortem was not allowed.

I attribute death in this case to the direct action of the enormous amount of toxin in the blood on a weakened heart.

It has been demonstrated by animal experiments that chloretone kills by acting on the respiratory centre without affecting the circulation. It will be noted in this case that while the pulse was very bad, the respirations were only slightly affected, and that the patient died from failure of the circulation, not the respiration. If I were again confronted with a similar condition, I would bleed the patient freely, replacing the blood with salt solution. This would immediately remove a large amount of toxin and possibly prevent heart failure.

In summarizing these cases it will be seen that three of them, Cases I, II, and IV, were of the type which almost always die. Case III might have recovered; Case V would probably have recovered under any treatment; while Case VI was the type which will usually die despite treatment. It will be noticed that the muscular manifestations were completely controlled in every case by the chloretone. This is all chloretone will do. It has no effect on the toxin circulating in the blood, nor will it break up the combination between the nerve cells and the toxin, when this combination has taken place. It has the further merit of being harmless. No fatal cases following its use have been reported although enormous doses have been taken with suicidal intent. In addition to this, it is easy of administration. If the patient can swallow, it can be given by mouth dissolved in dilute alcohol. If this is not possible, it can be given per rectum dissolved in hot olive oil. I have given it this way in my later cases because its action is almost as prompt as when given by mouth, and it does not disturb the stomach. In addition to this chloretone lowers the temperature and has a slight diuretic action.

ANEURISMS IN YOUNG PEOPLE.*

BY THEODORE A. McGRAW, M.D.,

OF DETROIT, MICH.,

Professor of Surgery in the Detroit College of Medicine; Surgeon to St. Mary's
and the Harper Hospitals.

I HAVE had two cases of aneurism in young men of 16 and 17 years of age. They were both associated with great dilatation of the heart and, in both, the arteries were soft and frágile.

The first case occurred nearly thirty years ago. I have lost the notes which I made of it at the time, but have a very distinct recollection of its main features. A country boy of 17 years, while working in the field was seized with a sudden pain in the bend of the right elbow and became incapacitated for work. He came to me a week afterwards for examination and treatment.

I found a pulsating tumor of the lower end of the brachial artery, and a great enlargement with dilatation of the heart. I could elicit no history of rheumatism or syphilis.

I operated on him and found an aneurism of the brachial just above its bifurcation, about as large as a hickory nut. It had ruptured and was surrounded by a large quantity of extravasated blood. I tied the artery above and below the aneurism. The upper ligature cut through as soon as tied, and I was obliged to tie it again higher up.

At the end of three days a secondary hemorrhage occurred from the cardiac end of the artery. The ligature had cut through the soft arterial walls. This happened a third and a fourth time at intervals of between three and four days, necessitating repeated ligation, each succeeding one from half an inch to an inch above its predecessor. I finally succeeded in checking the hemorrhage permanently by passing a pin under the vessel at its origin from the axillary and pressing its walls together by a figure-of-eight thread wound carefully and not too tightly around it. The wounds were at no time septic, and healed quickly. He left the

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hospital with· full use of his arm, but died at his home from the heart trouble a year and a half afterwards.

The second case was that of a boy sixteen years of age, from Wyandotte, Mich., who entered St. Mary's Hospital, Detroit, on June 26, 1908, and came under my care. According to the history which I elicited from himself and his mother, he had been subjected during his life to many hardships, and had worked beyond his strength. He had not been conscious, however, of any cardiac or pulmonary trouble, and had believed himself well until three weeks before his admission to the hospital, when he was seized with pain under the right knee. This was diagnosticated as rheumatism.

It was positively stated that he had never, prior to the outset of this malady, suffered from rheumatism or any other acute or constitutional disease. He gave no history of strain or injury. A few days before I saw him a pulsating swelling was noticed in the right popliteal space, and he was sent to Detroit for treatment.

On examination, I found a pale, anæmic lad with a very large dilated heart and a soft, collapsible pulse. The apex beat in the sixth intercostal space half an inch outside of the nipple. There was a loud, blowing murmur, heard equally at base and apex, and confusing both sounds of the heart. His pulse, 100 in the minute, was very soft and compressible. His temperature was 100° F.

In the right popliteal space there was a pulsating tumor filling up the whole concavity. His leg was flexed and could not be extended without pain. There was a constant pain, even when he was in bed and quiet, which radiated down the leg to the foot. His urine was normal. There was no leucocytosis. The report of blood examination showed the amount of hæmoglobin to be 80 per cent. of normal. He had no cough nor dyspnœa nor other evidence of lung complication, but was so weak and exhausted that I deferred operating until his strength could be recuperated by rest and treatment.

During the next three weeks he regained his appetite and grew stronger, but his temperature continued to fluctuate between 99° F. and 100° F. and his complaint of pain was constant.

The operation was performed on July 18, a hypodermic injection of morphine having been administered a quarter of an hour before the ether anæsthesia. Through a long longitudinal incis-

ion a cavity was opened in the ham, containing a large mass of extravasated blood. When this had been evacuated and the parts cleansed there was revealed an exceedingly thin and small aneurismal sac with a linear rent in its posterior surface. The sac was nowhere adherent to the surrounding tissues, and its walls, thin and fragile as a peritoneal membrane, were not re-enforced by fibrinous or calcareous deposit. On freely enlarging the opening, I found that the sac consisted of the whole posterior wall to the extent of half an inch. The anterior wall appeared as a groove in the tissues, extending from the upper to the lower orifice of the popliteal artery. I could detect nothing which had any resemblance to embolism, and the condition was rather that of a vessel distended beyond its tensile capacity than one that had been subjected to septic deposits and irritations.

I had thought to use the Matas method in operating, but found the arterial and sac walls too soft and thin for that procedure. The sutures cut through the tissues on the slightest traction, and the first ligature, which was tied with some force, came away in my hands. I tied the artery above and below the sac, therefore, with great care, drawing the threads together just tight enough to prevent hemorrhage. A rubber drain was inserted, and the wound closed around it by layers of catgut sutures. The drain was removed on the third day, the wound healed by first intention, and I was able, at the end of a week, to apply a weight to the foot to extend the flexed knee.

On August 18 he was sent home, walking upon a well leg and with no untoward symptoms. He died on November 14, but I did not hear of his demise until some time in December and was prevented from making a post-mortem examination. On the death certificate it was stated that he died of endocarditis.

These cases seem to me to have some importance because of their bearing on the pathology of aneurisms in young people. In both cases there was great enlargement and dilatation of the heart, without history of rheumatism or other acute disease. In both, the arteries, though apparently normal, were very soft and friable. In the second case this may have been the result of the long irritation due to the rupture of the sac, but in the first case, in which the whole brachial artery was affected, it is impossible to regard the arterial insufficiency

as the result of a merely local affection. The entire absence in both cases of all evidences of arteriosclerosis, septic infection and embolism would seem to indicate that the relations between the cardiac disease and the arterial were those rather of coincident affections than those of cause and effect. The question arises whether many cardiac maladies occurring in childhood and youth may not be the result of failures in development which involve not only the heart but also the whole vascular system. We might expect to find these relations more especially in those dilatations of the heart in which the valvular affections were not sufficient in themselves to account for the severity of symptoms.

In children, with defects in development of this nature, hardships and severe labors may act as supplementary and exciting causes of arterial ruptures and aneurisms by bringing strains upon the vessels which they are not able to resist.

It is curious that the congenital insufficiency of the circulatory system which undoubtedly exists in some children has received only a very grudging notice on the part of pathologists.

Tubby states that " there exist in young people traumatic aneurisms without pre-existing inflammatory lesions of the arteries. He believed that rheumatism and syphilis, and probably alcoholism, creates in the descendants not only lesions but also congenital malformations of the arteries, which consist in a more or less complete disappearance of the elastic fibres, of the middle coat, and favors the appearance of aneurism in the fœtus and infant."

Jacobi includes among the causes of aneurism in children a congenital incompetency of the walls of the blood-vessels. This view of the etiology of many aneurisms in children finds support in a number of cases on record in which the heart is reported as normal. They are:

1. That of ARMITAGE, of a child seven and a half years old who had suffered from palpitation from her earliest infancy. She died of an aortic aneurism. The arteries on obduction, were found to be free from atheroma or roughness.

2. WORMASKI's case of aneurism of the ulnar artery and palmar arch in a girl of twelve. The child had had no hereditary taint or rheumatism, and he attributed the disease to a strain received from lifting.

3. KEEN's case of a spontaneous arteriovenous aneurism of the arm and also an aneurism of the chest in a girl of eighteen.

4. ROGERS, a girl of ten with aortic aneurism; she had never had rheumatism or scarlet fever.

5. RIES, a girl of five, with aortic aneurism.

6. PENDEL, aortic aneurism in a girl of twelve. He referred the trouble to a fall on the chest received six years before the development. We may be permitted to doubt whether there was any causal connection between the injury and the aneurism.

7. F. G. SMITH. Boy of nine, with aortic aneurism.

8. BERRY. Boy of fifteen, died of aortic aneurism. He had never had rheumatism, and there was no evidence of hereditary syphilis. The only sign of heart trouble was a slight thickening of the aortic valves.

9. MIGUEL. Boy of fourteen, died of aortic aneurism.

We may hardly assume that these nine patients with normal hearts owed their maladies to embolism, either mechanical or septic, as the conditions which cause embolism were entirely absent from their histories. Neither are we justified, in my opinion, in ascribing them to an hypothetical endarteritis, of which there is no other evidence than the existence of the aneurism itself. How far we may go, however, in referring their origin to pre-natal disturbances is as yet an unsolved problem.

If we study the recorded cases of aneurism in children, we shall find very few satisfactory data on which to base our opinions as to their etiology. Dr. Charles Pfender compiled sixty-four cases for me from the literature in the Surgeon General's library. Thirty-two of these were so meagrely reported as to give no clue whatever to previous history or hereditary influences. Of the thirty-two remaining, six gave more or less uncertain histories of injury. One case was attributed somewhat doubtfully to an abscess which ruptured into the aorta.

In nine cases there was history of previous attacks of rheumatism. In ten it was positively stated that the patients had never suffered from that disease. In view of the fact that rheumatism is an exceedingly insidious disease in children,

often causing inflammation and dilatation of the heart before manifesting itself by muscular or arthritic pains, I cannot think that these figures represent, even approximately, the actual facts.

As regards syphilis, which is so generally credited with causing arterial degenerations and aneurisms, it is noticeable that in only one case, that of Wilson and Macy's, was there any evidence whatever of previous infection. Lebœuf, who is strongly disposed to regard hereditary syphilis as an important factor in the causation of arterial disease, admits, nevertheless, that he was unable to detect any signs of that disorder in his autopsies. It seems evident that the prevailing theories regarding this matter need careful study and revision.

In 5 cases aneurisms were found associated with tuberculosis; in 3 they were preceded by whooping cough. It does not appear that any of the 64 patients had had scarlet fever. Two cases were reported to have had measles and one to have had a streptococcus infection. It is impossible from these meagre data to draw positive and trustworthy conclusions.

The relations between cardiac disease and arterial dilatations are not yet thoroughly understood. Clinicians are inclined to attribute aneurisms which occur in conjunction with valvular affections to embolism. That embolism is sometimes a cause of aneurism cannot be doubted. That it is a very common factor in its production has not been proven. It is certain that in some cases acute infections like rheumatism, scarlet fever and typhoid fever and measles affect the arteries primarily, causing thickenings and erosions of the intima and inflammations of the media. Osler states that it is rare to find the arteries entirely free from disease. Even in children, small flecks of atheroma or fatty degeneration of the intima are by no means uncommon. It is not possible when cardiac and arterial diseases co-exist to distinguish those cases in which one is caused by the other from those in which the two arise simultaneously from the same infection. The difficulty in deciding as to the nature of these relations is increased by our inability to diagnosticate endarteritis in its acute stage.

Whatever symptoms occur, such as fever and pain, that it might present, are overshadowed and hidden from notice by the great cardiac disturbance. The heart disease is discovered in its early stages, while the associated arterial lesions do not attract attention until the subsequent degenerations have led to arterial dilatations. This may not occur for months or even years after the onset of the initial lesion, and often only when the artery is subjected to some sudden and unusual strain.

As regards the etiology of aneurisms in young people, we may say with some positiveness that in some cases there are congenital defects in development which are manifested by a thinness and softness of the middle arterial coats, and which render the arteries incompetent to resist even ordinary strains. We may surmise also that this condition may be due either to hereditary influences or to parental infections, but we have no data which enable us to determine with any exactness how important this factor is as a cause of arterial dilatation.

We have reason also to believe that the primary infections to which the arteries, especially, with the heart, are exposed, may induce lesions which may, in some cases, result in serious degenerations of the arterial coats and end in aneurisms, and there can be no doubt that emboli due to cardiac or other diseases may lodge in the arteries and affect them disastrously. The whole subject, however, needs to be studied *de novo* with more care in observing actual conditions and more criticism in judging the meaning of the ascertained facts.

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GUNSHOT INJURY OF THE BRAIN.*.

BY JOSEPH RANSOHOFF, M.D., F.R.C.S., (Eng.),

OF CINCINNATI.

Professor of Surgery in the Medical College of Ohio, University of Cincinnati.

IT may be fairly asserted that abscesses of the brain present many difficulties of diagnosis, and that autopsies out of number reveal opportunities missed. That they may long remain latent is of common observation. But latency may be seeming and the result of inaccurate observation. The latter probably happens in the majority of instances. A notable exception, a case of true latency, was observed by the writer in the instance of a boy whom he trephined at the request of Dr. E. W. Mitchell for a compound depressed fracture of the frontal bone.

The patient, a lad of seven, had fallen from his bicycle and sustained a fracture in the region of the right frontal eminence. The dura was not injured. The depressed bone was replaced. The union was absolutely by first intention and the recovery unattended by any evidence of infection so far as the most careful clinical and bacteriologic observation could show. The patient left the hospital two weeks after the operation. During more than three years the boy's condition and development were in every way normal. He never missed a day at school by reason of ill health; never complained of headache, and was in every way well. In his school work he frequently led his classes. Three years after his injury he was suddenly seized with violent headache after becoming overheated at skating. He died in coma within twenty-four hours after the onset of symptoms. The autopsy revealed a ruptured abscess which had been encapsulated. It was a little larger than a pigeon's egg and in the right

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* Read before the American Surgical Association, June 5, 1909.

frontal lobe directly under the site of the fracture. The bone scar was scarcely visible.

It may be of importance to note that the boy was the only child of very intelligent parents, who would certainly have noticed any deviation of health in him. It is, therefore, fair to assume that the abscess was latent during the time indicated.

The following case is that of an abscess seemingly latent for a number of years and one presenting a missed opportunity.

T. S. T. first presented himself to me June 3, 1907. He was then aged 43. Married. He has two children. The family history is negative. He has been a commercial traveller for five years. He was perfectly well until the 6th of May, 1899, when he was shot with a thirty-two calibre rifle fired at close range. The bullet entered an inch above the middle of the right zygoma. He remained conscious for a short time after he was injured and gave directions about calling a physician. He was not unconscious at any time. There was a short period of stupor which supervened about six hours after the injury was sustained and disappeared entirely after two days. From that time on he continued clear-headed. Immediately after the accident there was a paresis of the left side of the face, the arm, and the leg. This could not have been profound, as the patient got into a buggy, drove home, and alighted, with some assistance. He was in bed about seven weeks, after which time the paralysis began to improve. He was confined to the house altogether for about six months, and at the end of a year he was enabled to dress himself and go about. From that time forth he continued his business, which now was that of a stock broker, with few interruptions.

On the 1st of September, 1903, nearly four and a half years after the injury, the patient was seized with a severe convulsion associated with unconsciousness. The second attack occurred in February, 1904. Both of these occurred in a hotel room after retiring. During both of them he fell out of bed, and after the second he remained on the floor sleeping until morning. On the following days he was about his work as usual. During the following two years he had altogether four similar attacks. In

April, 1904, he consulted Dr. F. W. Langdon, to whom I am indebted for many of the clinical notes.

When the patient presented himself to me in mid-summer of 1907 with a view to operation for the relief of his epileptic seizures, his condition was as follows:

Stat. Præs.: Vigorous-looking man; height six feet; weight 220 pounds; pulse 76; heart and lungs normal; no evidence of increased intracranial pressure; no headaches at any time; ocular fundus normal; urine normal. His mental condition is normal in every regard. He is clear in his ideas and logical. There is no defect in speech, nor is there any trace of asteriognosis. The pupils act normally and the ocular muscles are unimpaired. Dr. Langdon found in 1903 a very slight weakness of the lower face on the left side and the mouth drawn slightly to the right. At the time of my examination this weakness had disappeared. Dr. Langdon also noted some dulness of taste and smell, but not localized on either side. This was not noticed in my examination. Movements of trunk and extremities normal. There is no inco-ordination. A dynometer test of the grasp of both hands is better than the average. The left sole is less sensitive than the right. The knee-jerks are weak but equal on the two sides. A most carful inquiry as to the history of the convulsions, of which the patient has about four a year, fails to show them to be of the Jacksonian type. X-ray plates were now taken by Dr. Thompson in anteroposterior and transverse diameters. They show the course of the bullet to have been slightly backwards, upwards, and inwards. The bullet was broken into three parts. The outer fragment was evidently in the temporal fossa and extracranial. The middle fragment was either just within or in the bony wall of the middle fossa. And the largest fragment was behind the sphenoidal sinus on a level with the cribriform plate, and it was impossible to state whether it was within the skull or not.

The writer believed the convulsions due to an irritation from either the second or third fragment or from a brain scar. But in the absence of any focal starting point of the convulsions, he was unable to determine which of the fragments caused them. It was natural to assume that the larger fragment was the one which, if an operation were determined upon, should have been the object of the search. Considering the excellent condition of the patient and the infrequency of the attacks, and the absence of the ordinary

FIG. 1.

Lateral skiagram of cranium.

FIG. 2

Anteroposterior skiagram of cranium.

FIG. 3.

signs of increased intracranial pressure, and that the attacks became less frequent under rest and bromide, an operation was not advised. The writer did not again see the patient alive.

He learns that about a year after his last visit to him there developed a paresis of the left side of the face and of the left arm. There also was noticeable a slight dragging of the left foot. While in this condition, the patient came to the city for consultation on the 20th of February, 1909. Because I was out of the city,'he concluded to return to his home, seventy miles away. An engagement was made for consultation two days later. While on the train that morning, he complained of a severe headache which came suddenly after a severe jolt. When he arrived in the city the headache became intense. Shortly after reaching his hotel profound coma supervened and the patient died ten hours after the onset of the acute cerebral symptoms.

The autopsy had to be hurried and was incomplete; only the head was examined. No effort was made to find the extracranial fragment. On removing the brain the right sphenotemporal lobe was found adherent to the middle fossa and removed with great difficulty. In the floor of this fossa was a small opening the size of the end of a lead pencil. The largest fragment was firmly imbedded in the cavernous sinus between two layers of the dura mater, and without question had been innocuous from the time of its lodgment there. The brain was removed as a whole and hardened and carefully examined by Dr. Wolfstein, neuropathologist of the Cincinnati Hospital, who has given me the report which follows.

Report of Dr. Wolfstein.—Brain given me for examination by Dr. Joseph Ransohoff showed an incision in the right hemisphere on the outer lateral surface evidently made during removal. No abnormalities on the convexity of either hemisphere. At the base of the right hemisphere situated directly underneath (and ventral) to the right cerebral peduncle is an egg-shaped cavity 4 cm. in diameter. On opening this cavity thick pus poured out and then the cavity was seen to have a depth of about an inch and a quarter and to be evidently walled off from the surrounding convolutions.

The cavity occupies a position at the base of the temperosphenoidal lobe extending forwards to the uncus, in fact to the anterior extremity of the sphenoidal lobe reaching to the Sylvian fissure, separated from it, however, by a portion of the compressed thin convolution before mentioned. It also occupies the anterior third, at least, of the gyrus occipito-temporalis and impinges upon the inferior temporal convolution. The

optic tract in its passage around the crus was in direct relationship with the roof of this cavity and may have been pressed upon, but does not appear in any way to be obliterated, although it does not appear to be as healthy as the tract on the opposite side. The optic chiasm, the mammillary bodies, and the third nerves appear perfectly healthy. On opening the cavity at the bottom, it extends inward into the substance of the uncus and the sphenoidal lobe as above mentioned and the wall of the cavity looks very much as if it had a pyogenic membranous lining. Lateral to the abscess cavity a firm substance can be felt, around which there is a marked fibrous thickening which is cut through with some difficulty, and encysted in the substance of this thickening a foreign body can be plainly felt. As said, it is completely surrounded by fibrous tissue.

On cutting through this tough fibrous thickening, a fragment of a bullet falls out, but it is remarkable how firmly encysted this piece of bullet was. I expected at first to find a large flattened mass of bullet, instead of which I found the tough fibrous material was five or six times the size of the bullet and in places a third of an inch thick.

On cutting away this mass, it was found that in its interior the mass was of the same consistency as cartilage. The abscess can be dissected loose without much difficulty from the structures which form its roof, and its roof lies directly under the medial convolutions of the island of Reil.

When the abscess cavity is removed completely a tongue of tissue forms its roof lying immediately ventral to the right crus cerebri. Immediately back of it can be seen the posterior edge of the right columna fornicis. There seems to be also a marked purulent infection of the overlying lateral ventricle. On turning the brain over and examining it from the top, a purulent infection of both lateral ventricles as well as the middle ventricle is very well marked.

The infection involves both the columnæ fornici and even the fibres of the upperlying corpus callosum. The tissues posterior to the roof of the middle ventricle, namely, the corpus callosum and the junction of the two columnæ fornici, are also the seat of purulent infection. On dividing these the choroid plexus appears and seems to be of a lusterless dirty hue, evidently also the seat of an inflammatory disturbance.

A secondary infection can be traced forward into the front end of the middle ventricle and along the anterior descending column of the fornix. On cutting through the cerebellum and the superior medullary velum exposing the corpora quadragemina and the floor of the fourth ventricle, it also presents the same dirty greenish appearance as above described.

In turning now to the corpus striatum on the right side, the infection seems to have extended pretty well out toward the lenticular nucleus and certainly has involved the fibres of the corona radiata in its outer aspect.

On cutting open the right optic thalamus and part of the right lenticular nucleus, the capsular fibres seem to be involved in their outer

half and certainly in the passage of the fibres from the capsule into the crus they have been markedly pressed upon by the abscess above mentioned and also no doubt involved in the inflammatory process. The two crura cerebri and the upper portion of the brain stem were saved for hardening in Miller's fluid to determine secondary degeneration.

The hemiplegia (think it was left) was due either to involvement of the pyramidal tract as it passed through the capsule interna or more probably to pressure of the abscess on the right crus. As said, the optic tract was not destroyed, but there may or may not have been symptoms on the part of the visual fields due to pressure.

REMARKS.

The case reported is another illustration of the fact that the right temporosphenoidal lobe may be the silent site of an abscess. Nearly ten years elapsed between the infliction of the injury and death. Immediately after the accident there were positive evidences of impairment of the internal capsule or of the pyramidal tract. It is likely that a hemorrhage slowly coming on by pressure caused the initial stupor and left-sided hemiparesis. With the gradual encapsulation of the clot, the focal pressure-symptoms disappeared. When the infection within the exudation occurred, it is impossible even to surmise. Although it is not without parallel elsewhere, it does seem very improbable that the infection which caused death had remained quiescent during nearly ten years.

Although the term " latent " might be used in the case reported, it would, in the light of subsequent events, be misused. I reluctantly quote from Mr. Ballance, " Is it not possible that in at least some of the latent cerebral cases, the latency has been in the faculties of the observer; not in the clinical reactions of the patient."

Had the patient been carefully observed at any time during the six months preceding death, it is practically certain that a lesion of the temporosphenoidal lobe would have been recognized and relieved by an operation. Before the paralysis supervened there were no symptoms except the general convulsions which were supposed to be the result of a brain scar, or due to the presence of the fragments of the bullet. My natural belief was that the convulsions were due to irritation

from the larger fragment which, on account of its position, had lodged near or within the cavernous sinus and could only be reached with the very greatest difficulty and danger to the patient. In the light of subsequent events I am certain that, had an operation been performed when the patient came under my observation in June, 1907, the abscess would have been at once encountered on opening the temporal fossa and the smaller fragment or real cause of the convulsions easily found. I am justified, I believe, in reporting this case as exemplifying an opportunity missed.

COMPLETE DETACHMENT OF THE FACIAL BONES FROM THE CRANIUM, TOGETHER WITH MULTIPLE FRACTURES OF THE SIDES AND BASE OF THE SKULL.*

RECOVERY. CONDITION AT THE END OF FOURTEEN MONTHS.

BY CHARLES A. POWERS, M.D.,

OF DENVER, COLO.,

THE following case is presented with brief comment. So far as I am able to ascertain, surgical literature presents no record of a similar injury followed by recovery.

Mrs. X., a lady of about 30 years, was thrown from her horse at 4.30 P.M. on March 27, 1908. It is probable that the horse fell on her head. She was seen by me twenty minutes after the accident, and at that time the following condition was noted. The patient was unconscious, the breathing was stertorous. The pulse was 70 per minute and of fair quality, the rectal temperature was 99°. There were moderate abrasions of the left side of the face. The patient was bleeding profusely from the nose and mouth; she was bleeding very freely from the right ear and moderately from the left ear. The face was greatly swollen and distorted. The orbital tissues were extremely swollen, protruded and ecchymosed. The features were in no way recognizable. On pressure the entire face could be freely moved from side to side and from above downward. On pressing the lower jaw against the upper jaw the face and orbital tissues showed upward. No injuries were found excepting those of the head.

Diagnosis: Detachment of the facial bones from the cranium with fractures of the base of the skull. Prognosis, very grave.

Immediate and thorough cleansing was made of both ears; the auditory canals were moderately packed with sterile gauze and copious aseptic dressings applied. The nasal fossæ were cleansed as well as possible and packed with iodoform gauze. The pharynx was washed and sprayed.

During the evening the pulse and temperature began to rise.

* Read before the American Surgical Association, June 6, 1909.

The urine contained a moderate amount of albumin. Copious infusions of salt solution were ordered. Late in the evening the patient made a semi-response to questions. Examination of the pupils directly after the accident and during the evening showed them to be equal, moderately contracted, responding to light.

The following morning at nine o'clock the temperature was 106°, the pulse 150 and thready. Infusions of salt solution were liberally used. During the forenoon the patient replied to questions in a semi-intelligent way. During the day the temperature and pulse fell; at eight P.M. the temperature was 102°, the pulse 120. The following morning, the morning of March 29, the temperature was 100°, the pulse 90. During the time which had elapsed since the accident there had been pretty free bleeding from the right ear and moderate bleeding from the left ear. Scrupulous asepsis was maintained in the necessary change of dressings. The hemorrhage from the nose and pharynx practically ceased at about the end of twenty-four hours and frequent sprays of a boric solution were used

During the next few days the temperature averaged about 100°, the pulse was from 90 to 100, the mental attitude seemed to gradually improve and it was fair to assume that a condition of concussion of the brain rather than of compression had been present. At no time was there any paralysis of the extremities, the reflexes had been preserved. Forty-eight hours after the accident gentle attempts were made to mould the facial bones into place and these efforts were repeated from day to day. No retentive apparatus was thought advisable. The lower jaw seemed uninjured.

Four days after the accident skiagrams were taken by Dr. Childs. They are reproduced in Figures 1 and 2. There are doubtless other lesser fracture lines in addition to those shown. Dr. Childs's description of them is as follows:

" The skiagrams of Mrs. X., taken April 1, 1908, show the following conditions:

" A complete transverse fracture of the nasal bones 9 mm. distal to their articulation with the frontal bone, the fracture extending through the ethmoid and nasal process of the maxilla into either orbit. In the left orbit the fracture can be traced across the orbital plate of the maxilla and emerges near the external orbital process, thence is continued downward through the

FIG. 1.
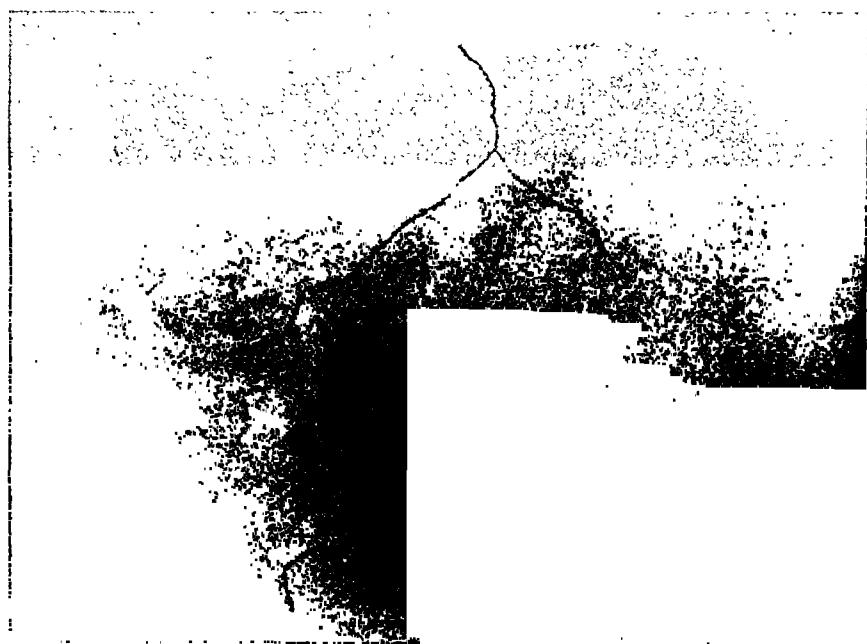
Complete detachment of the facial bones from the cranium,

FIG 2.

Complete detachment of the facial bones from the cranium,

tip of the zygoma at its junction with the malar bone, then passes backward and downward through the maxilla and pterygoid plate of the sphenoid, terminating 6 mm. above the level of the inferior surface of the palate bone. About midway of the left orbit there is a branching line of fracture which can be traced upward through the orbit into the frontal bone.

" In the right orbit there is a stellate fracture, one limb of which passes upward through the orbital plate of the frontal and a lower limb passes across the orbit, thence through the malar bone, continuing its course downward and backward through the maxilla and pterygoid plate of the sphenoid, terminating just above the level of the inferior surface of the palate bone.

" At the base of the skull there is a fracture extending backward from the petrous portion of the temporal into the occipital bone.

" *Diagnosis:* Complete transverse fracture of the bones in the upper part of the face, with basal fractures of the frontal, temporal and occipital bones."

On the sixth day the patient experienced a moderate chill followed by increased temperature and gradually lost the sight of the right eye. This was thought to be due to a compression of the optic nerve. Dr. J. M. Foster,[1] who assumed the care of the eyes shortly afterward, kindly gives me, under date of May 3, 1909, the following from his notes:

" I first saw Mrs. X. on the ninth day after the accident, April 4, 1908, at which time the swelling of the lids had greatly decreased, but she was unable to voluntarily raise the lids. The sight had apparently remained good in each eye until the evening of the sixth day when she noticed diminution in the left. This was accompanied by increase in temperature, rigor, and sweating. On the morning of the seventh day she was unable to see a lighted candle with the left eye. There was complete ptosis of the right side, but on the left it was not quite so marked. No facial paralysis. Conjunctiva was congested, slight mucous secretion. Each eye-ball was absolutely fixed, no motion in any direction, marked bulging outward. The pupils were slightly dilated, the right sluggish, the left immovable. The right disc was slightly blurred on the edges, vessels normal. There was a

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[1] I am also indebted to Drs. Pershing, Bonney and Jayne for kind aid in the care of the patient.

grayish pallor over the entire retina. The left disc was quite pale, vessels contracted, especially the arteries, and grayish color around the disc and the macula. No effusion nor cherry red spot. At this time it seemed probable that the condition was the result of pressure upon the blood-vessels and nerves at their entrance to the orbit, less probably due to an embolism of the arteria centralis retinæ. V.R. 20/80, V.L. nil.

"April 27, 1908. Examination showed that the condition of the right eye was practically unchanged except that the internal rectus showed slight inclination to turn the ball somewhat inward and the ptosis was less pronounced. The movements of the left eye were good in all directions and the ophthalmoscope' showed a typical picture of atrophy of the optic nerve.

"On May 8, 1908, the condition continued to improve as far as the movements of the left eye were concerned. There was very little ptosis remaining and the eye moved readily in all directions. The right eye, however, had made but little change. Ptosis had improved somewhat and the power of the internal rectus was slightly greater. Vision equalled 20/70.

"On July 17, after having used the galvanic current applied directly to the muscular attachments on the right eye the past three weeks, it is found that the internal rectus and the superior and inferior recti muscles are regaining some strength, but the external is absolutely without function. V.R. equals 20/40 with .25 = –1 C. 180. = 20/30. V.L. nil.

"April 18, 1909. The ptosis of the right eye is almost overcome, but there is still slight drooping of the lid and the internal rectus has pulled the right eye into the inner angle for the past six months producing very pronounced paralytic squint. The superior and inferior recti have only regained a small portion of their normal strength. The external rectus remains paralyzed. Tenotomy of the internal rectus * followed by shortening and advancement of the right external rectus brings the eye to primary position. The hearing in each ear is normal for voice, whisper and watch."

After the first few days the patient gradually underwent improvement. She never complained of pain, she was able to be nourished, the bowels gave no trouble. At times there was a trace of albumin in the urine, at other times urine was free from this. There was a moderate cerebrospinal discharge from the

left ear for a few days and a considerable similar discharge from the right ear for many days. In due course of time this completely ceased. The hearing remained good and has never been impaired. It was about two weeks before recent events became fixed in the memory.

As has been said, the facial bones were gently and carefully moulded into place. They underwent complete union at the end of five weeks. Resultant deformity is but very slight. The face is a very little dropped, the distance between the tip of the nose and the forehead is a little increased. The nose is in a straight line. There is a little prominence of the left malar bone. Articulation between the left lower and upper teeth is not quite perfect. There is perfect articulation on the right side.

Mrs. X. gradually became restored to practically complete health. At this time, fourteen months after the accident, aside from the disability of the eyes, before noted, she is in a practically normal condition.

A thorough search of surgical literature, in which quest I have had the kind aid of Dr. F. Robbins, of New York, fails to reveal a parallel case. The only observation definitely bearing on the subject which we have been able to find is the following by La Personne and Le Fort in *La Presse Médicale,* No. lxii, 1900:

Their patient was a man 26 years of age who met with an accident in such a way that his face was thrust on the ground and his head held fast for several minutes under a heavy stone. Details of the accident were not remembered by the patient, although he claimed not to have become unconscious. There were a few insignificant abrasions of the hairy scalp, while the face had borne the brunt of the injury. The nasal bones, the upper jaws, and the right inferior maxilla were separated from the remaining bones and the upper jaws could be moved from side to side and from above downward, under crepitation. In spite of these severe injuries the face healed, but not without considerable deformity, which caused the patient to seek admission to the hospital. Numerous bluish-black scars were seen surrounding the right eye; the orbit was much contracted and the eyeball was adherent to the conjunctiva on the outer side; there was paralysis of the right external rectus muscle, and internal strabismus. The root of the nose was enlarged and pushed over to the right; the right superior maxilla was flattened and sunken; there was slight facial paralysis. The lower margin of the orbit was broken through and the inner portion was 2-3 mm. lower than the outer. The skin in the region of the outer side of the upper jaw was anæsthetic.

By means of plastic procedures the patient's condition was much.

improved and the cosmetic deformity was corrected to a considerable extent. Ten days after the operation he asked to be discharged from the hospital, and six weeks later he was described as free from pain and having a wider palpebral slit, which began to show the eye-ball at the inner angle in spite of the marked internal strabismus.

La Personne and Le Fort say that this observation gives rise to a number of interesting questions. There were several complicated fractures and paralyses, the retrospective diagnosis of which is by no means easy. Beyond a doubt there was a large fracture involving the two superior maxillæ, separating their entire lower portion from the higher parts and the overlying bones; this transverse fracture separated the entire palatine arch from the remainder of the face. The pterygoid processes were in all probability broken off at the base and mobilized with the palatine arch, as is the rule in these fractures. The right malar bone was detached above at the level of its articulation with the frontal bone; outside, at the level of the xygomatic arch; within, it was separated from the superior maxilla; downwards and backwards, it remained adherent to the pyramid, which was shattered and penetrated in part into the maxillary sinus. Thus the malar bone, with the outer angle of the pyramid formed a second fragment, which underwent a to-and-fro motion causing the sinus wall to be pushed up from below. A third fragment was loosened in shape of the entire ascending ramus of the right maxillary, which became crowded upward into the orbit. This displacement led to very serious results: outward deviation of the palpebral slit and complete destruction of the nasal canal. It is very probable that the bones of the nose were fractured with the base of their frontal insertion, a very rare and extremely grave lesion. Moreover, there seems to have been a luxation of the right nasal bone on the ascending process of the maxillary bone of the same side, a luxation which is practically certain to be complicated by fracture. The lesions at the left orbital margin and the anæsthesia in the left suborbital region, serve to show that there was a fracture on this side; it is probable that there were lesions of a minor degree, but about symmetrical with those of the right side, in the region of the left malar bone.

THE PARATHYROID QUESTION.*

BY CHARLES H. MAYO, M.D.,

OF ROCHESTER, MINNESOTA,

Surgeon to St. Mary's Hospital.

FOR more than fifty years reference has been made by various authors to peculiar gland bodies that were quite regularly associated or connected with the thyroid glands.

Sandstrom's [1] excellent description of what he called " accessory thyroids " was given in 1880, and Gley [2] demonstrated later that tetany was caused by the removal of these glands in thyroidectomy. Rogowitz,[3] Christiani,[4] Zielenska,[5] and Hürthle [6] respectively described as embryonic thyroids similar bodies in various animals.

In 1895, Kohn [7] made note of four epithelial capsules to the individual, although more, or fewer have been noted occasionally.

In 1908, Welsh [8] gave us an exhaustive description of the parathyroids which he designated as, posterior superior and anterior inferior.

Moussu,[9] Vassale and Generali,[10] and Jeandelize believed that a deficiency of parathyroid secretion occurred in exophthalmic goitre, and they, with others, thought the same condition was the probable cause of various forms of convulsions.

Lundberg [12] believed that paralysis agitans was also caused by a deficiency of secretion, his theory being shown by Thompson [13] as erroneous in an examination of nine cases at autopsy. Thompson's statement is supported by other investigators.

As stated by the more careful observers, the parathyroid glands are four in number, usually without the true capsule of the thyroid gland. They are 6 or 7 mm. long, 3 to 4 mm. wide and 2.5 mm. thick. They are supplied by a terminal

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artery entering the hilus. The arterial supply is mostly derived from the inferior thyroid artery, or from the anastomotic branch between the superior and inferior thyroid arteries. The parathyroid glands are often designated as *superior* or *external,* and *inferior* or *internal.*

There are wide variations in the effect of the removal of the parathyroids in various animals, especially the herbivorous animals, in whom the bodies may be irregularly placed at a distance from or within the thyroid, making it difficult to be positive as to their complete removal. Extirpation of the parathyroids of animals, especially in dogs, is quite regularly followed by tetany.

The association of function of the glands like the thyroid, parathyroid, thymus, suprarenal and others become more marked as continued investigation discloses the various changes consequent to disease or removal of the various glands. It is probable that some of the glands act through the hormones or chemical messengers, and that others are more reflex in effect. MacCallum and Voegtlin [14] especially mark the changes in calcium metabolism incident to parathyroid deficiency.

The pathologic changes are of simple types, *i.e.,* degenerations, hemorrhages, cysts, and seldom tumors. There are about a dozen tumors of the parathyroid reported, most of these being found at autopsy, and all were benign adenomas.

From such reports it would appear that these glands as compared with other organs and lesions are singularly free from serious diseases, especially those of a surgical nature. This explains why our information is gained principally from accidental findings incident to their injury during operation upon associated structures and from direct experimental work upon animals, thereby differing from the more recent medical advances.

The greatest progress in our working knowledge of the pathology of the body in general has come from the treatment of surgical conditions, and from a consideration of pathologic changes in the living.

In the surgery of the thyroid, not considering sepsis, we have always had reason to fear hemorrhage both primary and secondary, as well as injury to the recurrent laryngeal nerves. Must we not be watchful of the parathyroids? While the deaths from their injury will probably be fewer than those from the first mentioned condition, the character of the death with convulsive seizures seems more shocking than from any other cause.

In 1200 operations for goitre we have seen no tetany, and it is possible that certain principles of operation which were developed long before there was a parathyroid question, may have contributed to the preservation of the parathyroid bodies.

Freedom from hemorrhage, i.e., a bloodless operation, has not been a marked feature, as the superior thyroid artery is usually the only large vessel ligated as it enters the gland. Other vessels are caught by many forceps as they pass through the capsule. The posterior capsule is carefully preserved in all operations upon the thyroid. We believe this technic best for the occasional or inexperienced operator, but possibly not necessary for the experienced surgeon who continuously maintains a dry wound. Cystic tumors or encapsulated adenomas are usually treated by the Partia-Socin-Billroth method of enucleation. Large colloid growths are treated by extirpation of the larger lobe and resection of the other side. When the enlargement is marked and nearly even, resection on both sides, as advocated by Mikulicz, is an excellent method of reduction.

Operations upon cases of hyperthyroidism are usually confined to one side, and the blood supply being free, there is but little danger of subsequent hypoparathyroidism.

As the removal of supposed lymph glands or small accessory thyroids is not essential in operation for goitre, we make it a rule to implant such bodies, when accidentally removed, into the capsule of the remaining lobe or in some other acceptable location in the exposed tissue of the neck. It is quite possible that the human being with four parathyroids

has some to spare, and that if those on one side are preserved, no untoward consequences will follow. This phenomenon has been noted in other double structures, the kidneys, ovaries, etc. In four instances in which one parathyroid body was removed we noted no unusual symptoms during recovery.

Should tetany follow an operation for the removal of the goitres, the indications are to administer calcium salts, preferably the lactate, in 4 to 5 per cent. solution intravenously, by stomach, or by rectal enemata. This has been found most efficient in dogs, by Voegtlin and MacCallum, although Beebe and Berkeley [15] in a similar series of cases of experimental tetany were not so favorably impressed with the efficacy of the calcium as with the use of their parathyroid serum.

In experimental tetany, bleeding seems to be of temporary benefit, but it is probable that in most human beings in which it occurs, that the operation will have served that purpose.

If the above remedies can but maintain life until parathyroid glands can be secured, transplanted and function obtained, it may be possible to tide the patient over into a chronic state which may later become a cure.

In a report of cases and of experimental work, Halsted [16] reports having secured benefit not only from the use of serum, but from feeding both dried and fresh beeves parathyroids. He found it necessary, in order to secure the success of the transplanting of the parathyroids, to first cause a parathyroid deficiency. While he obtains the best results by implanting the glands beneath the posterior sheath of the rectus abdominus, others have apparently succeeded by grafts into the remaining lobe of the thyroid, into the spleen, peritoneum and other locations.

BIBLIOGRAPHY.

[1] Sandstrom: Lakereförenings Förhandlingar, Upsala, 1880.
[2] Gley: Comptes Rendus de la Soc. de Biol., 1891-95-97.
[3] Rogowitz: Arch. de Phys. Nor. et Path., 1888.
[4] Christiani: Arch. de Phys. Nor. et Path., 1893.
[5] Zielenski: Virchow's Arch., cxxxvi, 170, 1894.
[6] Hürthle: Arch. f. die gesammte Phys., lvi, 1, 1894.
[7] Kohn: Archiv. f. mik. Anat., xliv, 366, 1895.

[5] Welsh: Jour. of Anat. and Phys., xxxii, 292–380, 1898.

[9] Moussu: Comptes Rendus de la Soc. de Biol., No. 2 and 3, 1897.

[10] Vassale and Generali: Revista de Path. nerv. e mentali, c and ccxciv, 1896.

[11] Jeandelize-Lundberg: Zeit. f. Nervenheil-Kunde, xxvii, H. 5–4 217, 1904.

[12] Lundberg: Deut. Zeit. f. Nervenheil-Kunde, xxvii, p. 743, 1904.

[13] Thompson and Harris: Jour. Med. Research, July, 1908.

[14] MacCallum and Voegtlin: Johns Hopkins Hosp. Bulletin, March, 1908.

[15] Beebe and Berkeley: Proc. of the Soc. for Exper. Biol. and Med., iv, j. 64, 'o 64, 1907.

[16] Halsted: Am. Jour. Med. Sciences, July, 1907. ANNALS OF SURGERY, Oct., 1907. Soc. Exper. Biol. and Med., 1908.

THE HISTOPATHOLOGY OF GOITRE.

BASED UPON THE MICROSCOPICAL STUDY OF OVER FIFTY CASES OF THYROIDEC-
TOMY, WITH HISTORIES OF THE MOST IMPORTANT.*

BY FRANCIS J. SHEPHERD, M.D.,

AND

C. W. DUVAL, M.D.,

OF MONTREAL, CANADA.

MacCallum, of Baltimore, in a recent article on the pathology of exophthalmic goitre, describes certain histological changes in the thyroid gland which he regards as diagnostic of the disease. These microscopic changes he depicts as a budding or infolding of the acinal epithelium, together with certain alterations in the morphological character of the lining cells. His observations were made upon a number of cases of exophthalmic goitre, every one of them presenting the characteristic picture to a greater or less degree. Even in the very early stages of the disease the histopathological change could be made out in some part of the gland.

In view of this work we were led to make a careful comparative study of fifty or more consecutive cases of thyroid conditions, including all varieties of gland disturbances and without special reference to Graves's disease. In this way we considered it possible to ascertain whether any pathological picture characterizes the thyroid gland in exophthalmic goitre distinctively from other conditions.

Fifty-nine cases in all were carefully studied histologically. Eighteen cases were unquestionably Graves's disease, two of which proved fatal. The infolding and budding of the acinal epithelium was present in some parts of the gland in 20 cases. The gland presented tumor formation in three cases of the series, viz..: carcinoma in one, intercystic papilloma in another, and angioma in still another. Chronic inflammation in the

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form of lymphoid- and plasma-cell infiltration, together with an increase in fibrous-tissue stroma, occurred 29 times. Eleven cases were of a simple cystic condition. In each case many sections were obtained for microscopic study and from various parts of the gland. The tissue was fixed in Zenker's fluid, formalin, and alcohol, and embedded in paraffin. Sections were stained in eosinomethylene blue, hæmatoxylin-eosin, and Mallory's connective-tissue stain.

For convenience of description the histopathological changes that occurred in this series of thyroid glands may be divided into six groups:

The *first* type is characterized by a subacute inflammation in which the supporting framework of connective tissue is infiltrated with lymphoid and plasma cells. The cellular exudate is usually focal, though sometimes it is diffusely distributed throughout the interacinal tissue.

The *second* type of lesion is distinctly proliferative in character; the connective-tissue trabeculæ and acinal framework are markedly increased. This fibrous new growth presents the essential change. Often dense foci of leucocytes, including plasma and lymphoid cells and polynuclear neutrophiles, infiltrate the areas of connective tissue. One of the striking features in this type of chronic thyroiditis is the occurrence of sharply defined collections of cells whose architecture resembles the so-called " tracoma bodies," or even the lymph nodes. Encircling these bodies are dense collections of mononuclear lymphocytes. The cells comprising these bodies are 10–12 microns in diameter and possess a single ovoid vesicular nucleus and pale-staining granular protoplasm. Whether the cells are of endothelial origin cannot be definitely stated, though in our opinion it would seem to be the explanation.

The *third* type of lesion is characterized by vascular changes. These usually take the form of an obliterating end-arteritis, though in some vessels the lesion appears as a degeneration especially of the media. Thrombosis is occasionally seen. There is often associated with the vascular changes a well-marked perivascular increase in fibrous tissue. With this

type of lesion hemorrhage into the acini is frequently encountered. The most interesting change, however, occurs in the gland epithelium. Here large areas of the parenchyma undergo necrosis, but the individual cells lining the alveoli remain intact; the picture is analogous to an extensive focal necrosis of the liver. The destruction undoubtedly results from occlusion of the vessel supplying a particular area, in which the occlusion is either endarteritic, thrombotic, or both.

A *fourth* group of changes includes the neoplasms, such as carcinoma, intercystic papilloma, and angioma.

The *fifth* type consists of an interstitial cellular (interacinal) hyperplasia which in many ways resembles a sarcomatous growth. Though the acini are apparently unchanged in size and structure they are uniformly separated by the enormous cellular increase in the tissues interposed.

The *sixth* type is represented by distinct hyperplasia of the gland parenchyma, which results in more or less tortuosity of the alveoli and infolding of the epithelium, the degree largely dependent upon the amount of colloid substance within the lumen.

The microscopic study of a large number of sections from each specimen of gland showed neither cellular arrangement nor cytological changes ordinarily detected by routine staining methods which could be regarded as specific for any special type of disease of the thyroid gland. Though infolding and budding of the acinal epithelium occurred in the gland of exophthalmic disease, the histological picture, however, was not at all constant. Occasionally infolding of the alveoli is entirely absent in unquestionable cases of Graves's disease; while, on the other hand, infolding and budding of the alveolar wall frequently occurs in simple goitre and other benign conditions of the thyroid gland in which there is hyperplasia.

In our series of examinations five pronounced cases of Graves's disease failed to show the slightest suggestion of infolding of the gland epithelium, though many sections and from all parts of the specimen, were examined. Again, in our cases we encountered a number of cystic goitres and glands,

Fig. 1.
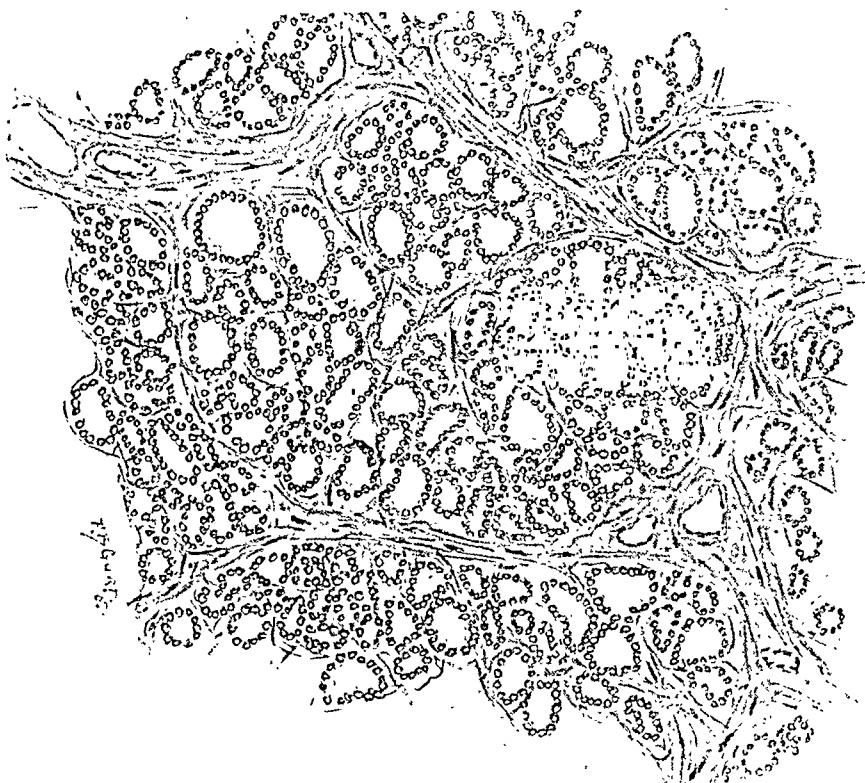
Normal thyroid gland.

Fig. 2.

Chronic inflammatory globule infiltrated with lymphoid cells.
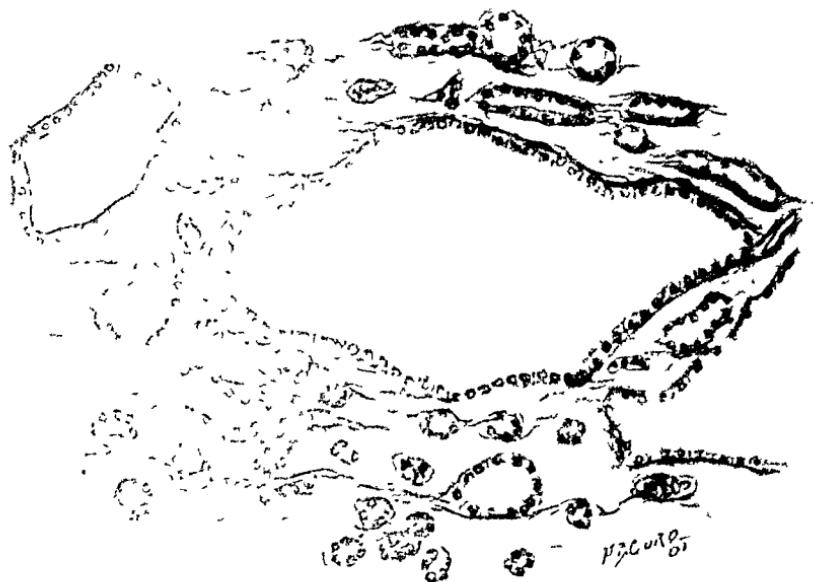
Cystic thyroiditis

FIG. 4

Adenocarcinoma.

Fig. 5.
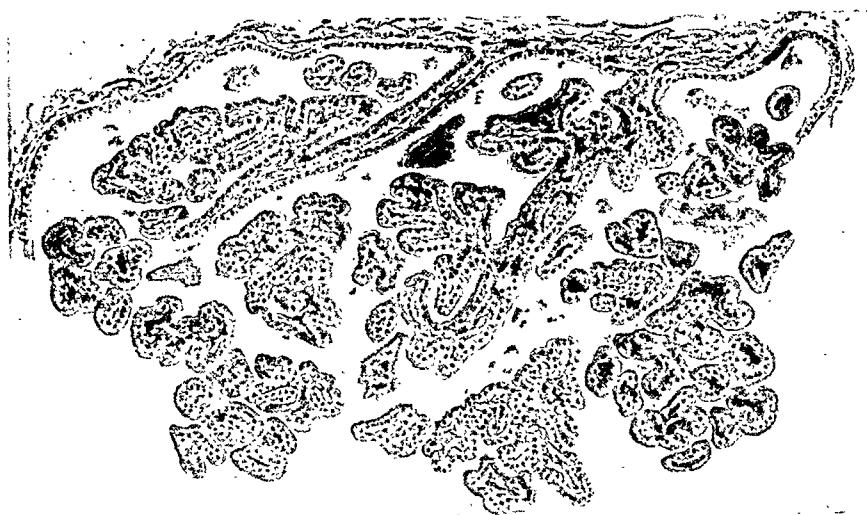
Intracystic papilloma.

Fig. 6.
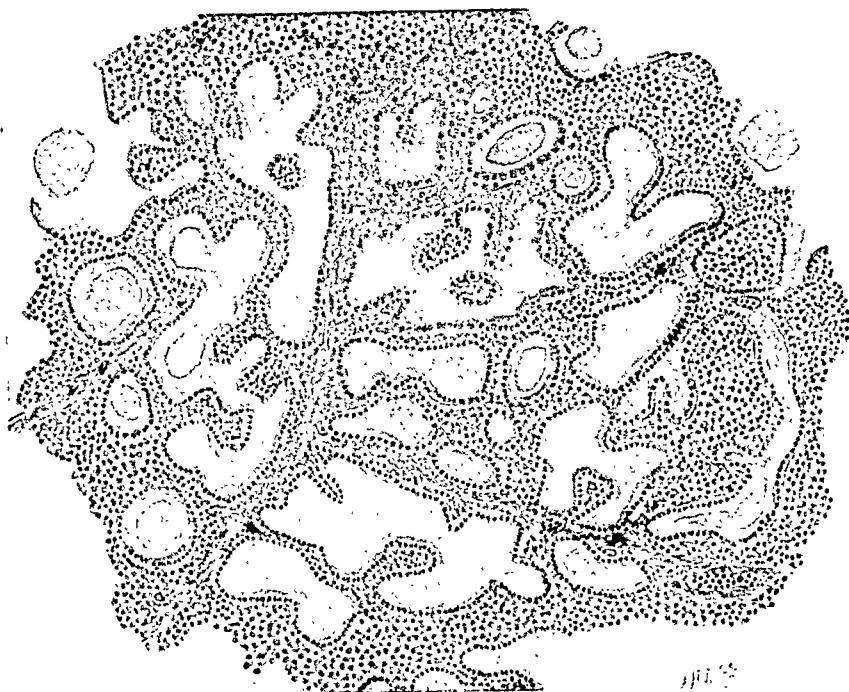
Interacinal hyperplasia.

FIG. 7.
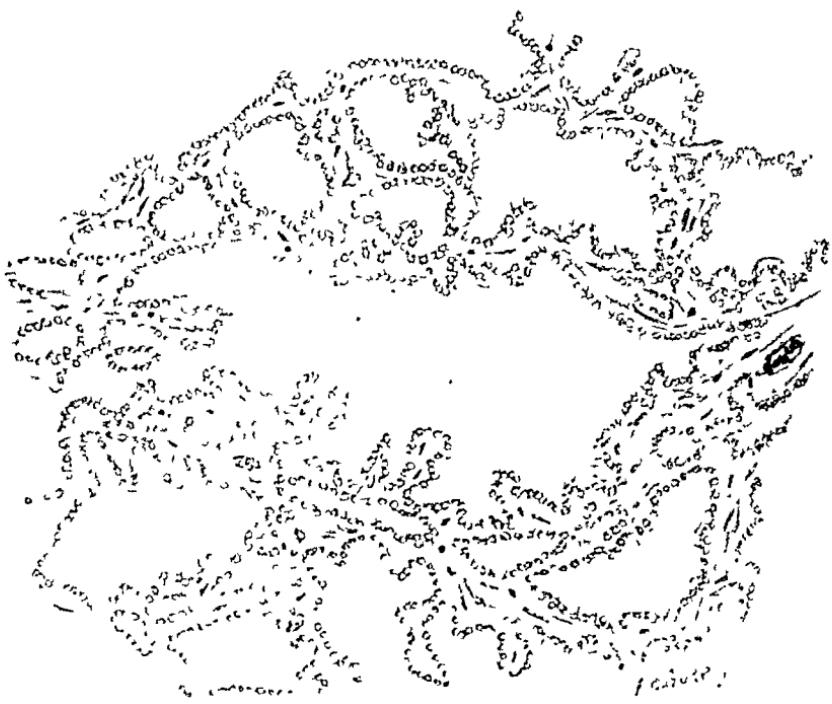
Marked glandular hyperplasia, showing infolding and budding of the acini. *Not* a case of exophthalmic goitre.

FIG. 8.
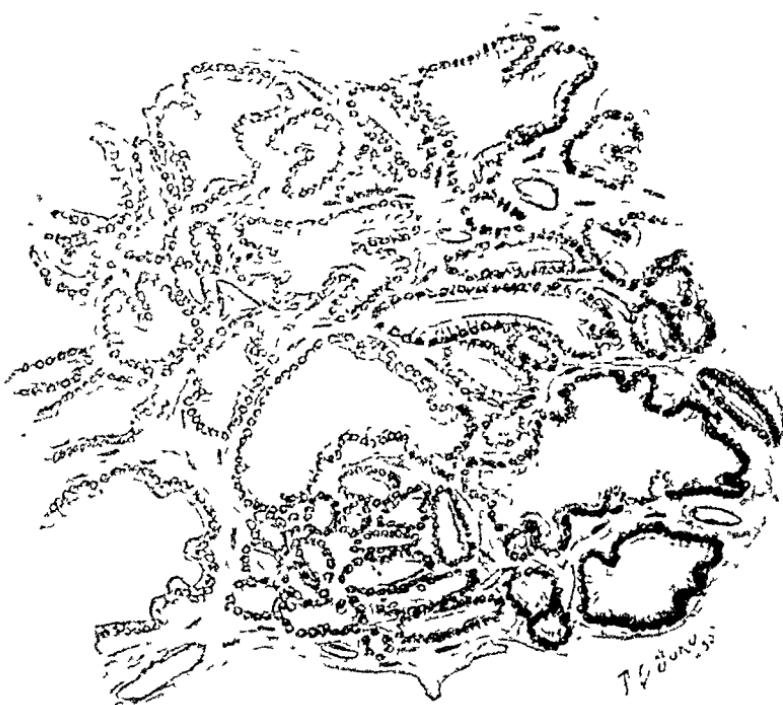
Slight hyperplasia (infolding and budding). Fatal case of exophthalmic goitre, not operated upon.

the seat of extensive neoplastic growth, that presented the perfectly typical picture of infolding and budding of the parenchymal cells.

Alterations in the morphological character of the epithelium—for example, several layers of cells lining the alveolar walls, the flattened type of cell becoming columnar, the change in chromatin-content of the nuclei, etc.—we have not found constant for any one pathological condition of the thyroid gland. Whether the lining epithelium of the gland is columnar or flattened depends upon the amount of colloid material within the lumen. It is noteworthy, in parts of the glands that show distinct histological changes of a hyperplastic nature, to find a marked diminution of the amount of colloid; very often there is an apparent absence of this material. Though the epithelium shows no appreciable microscopical alteration in cell morphology, there is undoubtedly a decided change in cell function as evidenced by the lack of colloid production. The absence of acinal contents naturally permits of a columnar type of cell lining.

Only rarely in thyroid hyperplasia were we able to detect more than two layers of epithelial cells lining the acini. Not even in the extreme grade of exophthalmic goitre were the cells heaped up. Often what appeared as several layers of " focal budding " could be explained by the fact that the knife had sectioned the gland alveoli at various places.

Infolding of the epithelium may occur in any thyroid gland when active hypertrophy is going on, especially in the absence of colloid production, no matter what the cause. The same fundamental principle governing the phenomena is also met with in other glandular organs which are the seat of hypertrophy; for example, the prostate, where the infolding is sometimes beautifully illustrated.

In some instances three or more of the above described types of lesions occur in the same gland, while in others the histological change is confined to one type. It is especially noteworthy in the gland of exophthalmic disease to find multiple lesions, widely separated and distinctive in character, though

the lesion may be single and confined to one area and without histological variation.

The following cases are detailed in illustration of our findings:

CASES OF TRUE GRAVES'S DISEASE WITHOUT ANY INFOLDING AND
BUDDING OF THE EPITHELIUM, WITH OR WITHOUT MUCH
INCREASE IN CONNECTIVE TISSUE.

CASE I.—Miss G., aged 29. Has had a slightly enlarged neck for some years; on examination only a small nodule can be felt above the sternum. Is excessively nervous, has tachycardia (pulse 100–120), tremors, marked exophthalmos. Operation: removed two large lobes situated beneath the sternum. Microscopic examination shows no infolding or budding of the epithelium, but there was a cystic condition and acini filled with colloid, some increase of connective tissue which contains collections of lymphoid and plasma cells; and some interstitial hemorrhage.

CASE II.—Miss B., aged 38. Had been treated in the medical wards of the Montreal General Hospital for six months for a very severe form of Graves's disease. Tachycardia (130–140), tremors, exophthalmos, dilated right heart, extreme emaciation, etc. Removed most of a not very large thyroid and ligated all the vessels; and yet the microscopic examination showed no infolding and budding of epithelium, but much colloid and slight increase of connective tissue.

CASE III.—Miss C., aged 24. Some years ago noticed a small lump in the thyroid. At the same time got excessively nervous, pulse ranged from 130–140, with marked palpitation. When I saw her she had an enlarged thyroid, tremors, slight exophthalmos, Stellwag's sign, pulse 130, breathlessness, unable to go upstairs. Removed the right lobe and isthmus and tied all the thyroids. After operation marked thyroidism for twenty-four hours. On·microscopic examination no infolding or budding of epithelium found, but much colloid and some increase of connective tissue.

CASE IV.—Henry H., aged 53. Great nervousness, tachycardia, tremors, emaciation, Stellwag's sign, commencing enlargement of right heart. On microscopical examination found no infolding of epithelium but very small acini, intra-acinal hemorrhage, and the gland markedly cystic in many places.

CASE V.—Miss P. B., aged 25. For two years had been excessively nervous, but no enlargement of the thyroid gland. Then enlargement was noticed and at the same time her eyes became prominent. Became unfit for her work of teaching and consulted Dr. Shepherd. At this time it was noted that she had considerable enlargement of both lobes of the thyroid, which were soft and vascular. Eyes very prominent and both Stellwag's and Graefe's signs present. Excessive nervousness, tremors, loss of flesh, with tachycardia (130–140), breathlessness. She also had temperature and some swelling of legs. The right heart was moderately distended. The case was one of well-marked Graves's disease, and she was admitted to the Hospital and treated medically for some weeks. At her earnest request an operation was performed and the right lobe of the thyroid and the isthmus removed; the left superior thyroid was tied. She did well for twelve hours, when her pulse became uncountable; she was excessively nervous, tossing about the bed, and soon became delirious and died twenty-four hours after operation. Her temperature never rose above 99.5°. The microscopic examination showed no infolding or budding of epithelium, but the acini were much increased and distended with colloid and the epithelium lining them was flattened.

CASES WITH MARKED INFOLDING AND BUDDING OF EPITHELIUM OF THE GLAND AND YET NO GRAVES'S DISEASE.

CASE I.—Mrs. B., aged 33. For many years had an enlargement of the neck on right side; at times larger than at others. Some two months before seeing her it had grown very rapidly. On examination was found a round, smooth tumor of the right lobe of the thyroid the size of a Tangerine orange; did not extend below the bony thorax, and appeared to be a large tense cyst. No tachycardia, no tremors, no exophthalmos, and no difficulty in breathing or swallowing; evidently a very nervous woman. Removed right lobe of thyroid which contained one large cyst and several small ones.

CASE II.—Miss H., aged 25. Has had a swelling of neck since she was 16 years old; tumor in mid-line. Has never grown rapidly. Has some breathlessness on exertion and attacks of dyspnœa, no tremors, no exophthalmos; pulse 90; considerable dysphagia at times when solids are taken. Operation: removed

an adenoma by enucleation. All symptoms relieved. In addition to infolding there was chronic inflammation and increase in connective tissue.

CASE III.—Mrs. D., aged 54. Two years ago noticed a small lump on the left lobe of the thyroid; has grown rapidly. On examination found one large and one small tumor in left lobe, largest, size of a large orange and other of a walnut, evidently cystic. No tachycardia, no tremors, no exophthalmos, no evidence of Graves's disease; pulse 80. Operation: removed left lobe and isthmus. In this case there was, in addition to the infolding and budding of epithelium, chronic inflammation with a lot of lymphoid and plasma cells and considerable colloid; no increase in connective tissue.

CASE IV.—Mrs. E., aged 39. For ten years had general enlargement of the thyroid, commenced when carrying first child. No tremors, no nervousness or ocular symptoms. Difficulty in swallowing; pulse 84. Hypertrophy and dilatation of epithelium; infolding and budding and much hyperplasia.

CASE V.—Miss F., aged 28. Has had " swelling of throat" for eight or nine years, which of late has caused some difficulty in breathing. Has taken thyroid extract with benefit. Of late the goitre has been increasing rapidly. On examination found an evenly enlarged thyroid, soft and vascular; pulse 98. No exophthalmos, no tremors, but only complains of breathlessness on exertion. Examination by larynx revealed pressure on the right side of the trachea opposite the fourth to the seventh rings of the trachea. Right lobe and isthmus removed. Much relieved by operation and was practically well six months later. Microscopic examination showed infolding of acinal epithelium in places and much hyperplasia; in others acini dilated with colloid and flattened epithelium.

CASE VI.—Miss A. H., aged 26. Six years ago noticed a small lump on the right side of the neck; grew very little until a few months before admission to Hospital under Dr. Bazin. Lately has been troubled with difficulty in swallowing and shortness of breath on exertion. Growth on right side and size of a goose egg. Pulse 78. No tremors, no exophthalmos or nervousness, absolutely no signs of Graves's disease. The growth was removed and on microscopical examination showed well-marked infolding and budding of acinal epithelium, with large areas of

increased connective tissue and diminution of colloid. In some parts there was acinal dilatation.

CASE VII.—Mrs. O., aged 40. Has had for some years a cyst of the thyroid which has been constantly increasing in size and from the discomfort and difficulty of breathing caused she desired operation. There were no nervous symptoms, no tachycardia, no tremors, in fact no symptoms indicative of Graves's disease. Dr. Elder removed the cyst by enucleation and she recovered rapidly. The microscopic appearance showed well-marked infolding and budding of the epithelium of the acini.

CASE VIII.—*Graves's disease with typical infolding, etc., in the right half of gland, which was first removed. Later great increase of left lobe with return of symptoms. This on removal showed no infolding of epithelium but merely acini distended with colloid and lined with flattened epithelium.*

Miss R. R., aged 23. For four years had suffered from symptoms of Graves's disease which came on with enlargement of the thyroid. Had tachycardia, tremors, nervousness, vomiting, high temperature, great exophthalmos, and enlargement of the right heart. Was in New York at the time and had the thyroids tied in one of the large hospitals, but secured no benefit from this treatment. In October, 1908, the right half of the thyroid was removed at the Montreal General Hospital with great benefit. The pulse was reduced to below 100, nervousness was less, and she was in every way better and able to return to her work. In the beginning of 1909, the left side of the gland began to enlarge rapidly and all the old symptoms returned. On admission to the Hospital in April, 1909, she seemed to be as bad as before the operation in 1908; in addition she had dilatation of the right pupil. The left half of the gland was removed, only a small piece being left on the trachea. She rapidly recovered from the operation and a month later all the symptoms had been much alleviated. The exophthalmos had disappeared from the right eye and the pupil was normal in size. The exophthalmos of the left eye, however, was as marked as ever. The microscopic appearance of the portion of gland first removed showed well-marked infolding and budding of the epithelium in the acini. The gland removed at the second operation showed no infolding of budding of the epithelium but merely acini lined with flattened epithelium and full of colloid.

EXCISION OF THE LARYNX FOR CARCINOMA.*

BY JAMES BELL, M.D.,

OF MONTREAL,

Professor of Surgery in McGill University; Surgeon to the Royal
Victoria Hospital.

JUDGING from the contributions on this subject which one
finds in surgical literature in the English language, it appears
to me that the operative treatment of malignant disease of the
larynx has received much less attention from English and
American surgeons than it has deserved.

My own experience in this field has been limited to twelve
complete laryngectomies and three thyrotomies with intra-
laryngeal operation; and while the results have been far from
brilliant they have been to me very instructive and very en-
couraging. In this communication I shall speak only of the
twelve complete laryngectomies, as the partial operations were
not satisfactory, and, in fact, were not well chosen.

My limited experience has shown me that the technical
difficulties of the operation and the danger from interference
with respiration during operation are much less than one would
" a priori " expect, and also that the great postoperative dan-
ger, justly so much dreaded in extensive operations involving
the pharynx, aspiration pneumonia, may be entirely or almost
entirely avoided by attention to the posture of the patient
during and after operation. This latter point has been
strongly insisted upon by Gluck, whose results have been
almost phenomenal. Compared, for example, with extensive
operations upon the tongue for cancer, I believe that extirpa-
tion of the larynx is a much simpler and safer operation, with
much less postoperative danger and much less danger of recur-
rence, as well as an operation which gives a much better func-
tional result.

In intrinsic laryngeal cancer the cartilaginous framework

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of the larynx resists for a long time the invasion of the lymphatic system, so that even in far-advanced disease there may be no extension beyond the boundaries of the larynx itself. Theoretically, the tributary lymphatics should be removed in every case; and in any case where there is evidence or suspicion of their involvement their removal is imperative. At the same time, intralaryngeal cancer produces symptoms from the very outset and on examination by a competent laryngologist, the new growth can usually be discovered and a portion of it removed for microscopical examination at a quite early stage of the disease. If by the aid of the microscope the diagnosis cannot be confirmed, operation should be undertaken with a view to an exploratory thyrotomy as a first step. The functional result after complete laryngectomy is usually very satisfactory, and the inconvenience slight, although the patient may, in some cases, have to wear a tracheal tube part of the time or even perhaps constantly.

Attempts to use an artificial larynx have been generally abandoned for many years, so that convalescence is expedited, swallowing is not interfered with and the operation itself is much simplified by the immediate closure of the pharynx.

It has been found that even without any form of phonation apparatus, satisfactory whispering speech can be developed. This was studied some years ago by Dr. J. Solis-Cohen (*Journal of the American Medical Association,* vol. xvi, p. 834) in a patient of his in whom speech was developed to a remarkable degree; and although no attempt was made in any of my cases to provide for an artificial larynx or to use any form of phonation apparatus, a very fair amount of whispering speech was developed after a little time, in all cases, so that the patient had very little inconvenience in communicating with his family and friends. In fact, the result, as far as speech was concerned, was not much inferior to that which I have observed in cases after the intralaryngeal removal of a new growth.

Since February, 1898, I have removed the larynx in 12 cases for carcinoma. Seven of these operations were for intrinsic laryngeal cancer, all far advanced; and in one of these,

the disease had extended to the pharynx. In 5, the primary disease was in the pharynx and had invaded the larynx secondarily. Of the 12 cases operated upon, 7 recovered; one of the 7, however, died on the fifty-eighth day from recurrence, or rather from extension, along the carotid glands into the mediastinum. Of the 5 deaths, 2 were from pneumonia—seven and fifteen days after operation respectively—and 2 from cardiac causes—four and five days respectively after operation. In one unfortunate case in which the patient was suffering from complete obstruction in the œsophagus, I was unable to get below the disease, and all that I could do was to fix a tube into the œsophagus after operation. Death occurred within three days. This woman had come from the Pacific coast for operation. She had not been able to swallow solids for a month, and at the time of operation she had not been able to swallow anything for seven days. I recommended gastrostomy, but she insisted upon radical operation, and I yielded, contrary to my judgment. It was impossible even at the operation to determine the lower limit of the disease in the œsophagus.

Of the 7 cases of intrinsic laryngeal cancer, 4 recovered and 3 died; and of the 5 cases in which the disease was primary in the pharynx, 3 recovered and 2 died.

In the first 4 cases, I did a preliminary tracheotomy and removed the larynx from above downwards. One of these cases died of pneumonia. In the last 8 cases, no preliminary tracheotomy was done, and the mass was removed from below upwards after fixation of the tracheal stump to the skin. This is undoubtedly a much better method of extirpating the larynx than by operating after preliminary tracheotomy. In all cases, operation was done with the patient in an exaggerated Trendelenburg position, and the patients kept in this position with the foot of the bed elevated for some days after operation. The intention was to allow of the secretions gravitating upwards rather than gravitating downwards into the trachea and invading the lungs. I am of the opinion that this attention to posture is most important. In all cases the pharynx was

closed and no attempt was made to prepare the patient for an artificial larynx.

Chloroform was the anæsthetic employed and no difficulty was experienced with the breathing even during the manipulations which were necessary to free the larynx from the neighboring tissues. The operative procedure was briefly as follows. With the patient in the Trendelenburg position and the neck extended, a median incision was made from the hyoid bone to a point a little below the cricoid cartilage. From the upper extremity of this incision on each side, a transverse incision was made to—or nearly to—the border of the sternomastoid muscle. The larynx was then separated from the surrounding structures. In cases of purely intralaryngeal growth, the box of the larynx was separated from its attached muscles by blunt dissection. In the cases in which infected glands or other structures were to be removed, the line of cleavage was made by dissection at a more remote point. In any case, after the mass to be removed—the larynx and whatever structures were to be removed with it—had been entirely isolated, the isthmus of the thyroid was divided between ligatures and the trachea freed for some distance below the cricoid. (The most difficult dissection of all is the separation of the cricoid cartilage and upper rings of the trachea from the upper part of the œsophagus.) Two strong silk sutures were then inserted into the trachea, usually between the second and third rings, and brought out so as to include the ring above. The trachea was then severed between the cricoid and the first ring or between the first and second rings, and the stump withdrawn through a transverse incision made through the skin and fascia a little below the lower end of the vertical incision; and sutured to the skin with silkworm gut sutures.

It is important, I believe, to bring the stump of the trachea well forward, so that at least one ring shall project beyond the skin. Subsequent retraction of the tissues will bring this down to the level of the neck.

It is also, I think, important to bring it out through a transverse incision to prevent the cartilaginous rings from

closing in upon the posterior membranous portion of the trachea, thus narrowing its lumen.

The larynx was then dissected from below upwards and removed. In all my cases the epiglottis was included in the mass removed. The pharynx was then, where possible, completely closed with the exception of a small opening on one or both sides at the outer extremity of the transverse incision, into which a drainage tube was inserted to allow of the draining away of the mouth and pharyngeal secretions and to prevent their accumulation in the pharynx. It was hoped in this way to avoid efforts at swallowing.

In some of the cases, which I shall mention specially, portions of the œsophagus and considerable areas of the pharyngeal structures were removed and complete restoration of the pharyngo-œsophageal canal was impossible.

In the cases in which the pharynx was completely closed, the question of feeding the patient had next to be considered. In my earlier cases, I introduced an œsophageal tube from the outer extremity of the transverse incision on one side and fed in this way for a time. In other cases, I introduced a tube through the nostril into the œsophagus; and in still others, I passed a tube into the œsophagus through the mouth, attaching a silk thread to it and allowing it to lie within the buccal cavity.

All these methods of feeding are more or less objectionable and, in my opinion, this is the most difficult question to deal with in connection with the operation.

In one case—Case III—I made no such provision for feeding—fed by rectum for twenty-four hours; then introduced a stomach tube twice during the next day; and on the third day allowed the patient to swallow; which he was quite capable of doing. The result was infection of the wound, considerable sloughing of tissue and a very much prolonged convalescence. This, I believe, to be a real source of danger in allowing the patient to swallow too early. I now feel disposed to go back to the method of inserting a large sized catheter into the œsophagus from the extremity of the transverse portion of the incision in the neck.

In all cases which survived, a satisfactory amount of whispering speech was developed.

Case I lived for either four or five years and died from recurrence in the lungs, as shown by autopsy. From his own account, he developed speech to a very satisfactory degree.

Case II lived four and a half years and died of an acute abdominal condition of seven days standing; either peritonitis or intestinal obstruction. He acquired a useful amount of speech.

Case III lived seven years and eight or nine months and died of recurrence at the base of the skull. He developed an amount of speech which enabled him to carry on an extensive business quite satisfactorily.

Case IX, who was operated upon in March, 1908, and last seen in January, 1909, was then in perfect health, but had not, up to that date, developed speech to any very great extent.

Cases X and XI are recent operations and did not develop a great degree of speech. Case XI died of pharyngeal recurrence six months after operation.

It is sometimes necessary before proceeding to complete laryngectomy to do a thyrotomy in order to demonstrate the condition within the larynx.

In all the cases which I have had to deal with, the diagnosis was unmistakable both as regards the nature of the disease and its extent; at all events it was quite clear that it was sufficiently extensive to justify a complete laryngectomy, and I cannot help thinking that complete laryngectomy is a safer operation, in most cases, and gives practically as good a result as hemilaryngectomy or intralaryngeal removal after thyrotomy, except when the disease is very limited and seen very early, and also that an exploratory thyrotomy should in most cases be unnecessary and must to some extent complicate the operation.

After-treatment, in addition to the question of feeding, is important. Some surgeons recommend that the patient should be allowed to sit up within a day or two after operation. The reasons given for this advice are, of course, convincing, but at the same time I believe that the necessity of guarding against

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the entrance of wound secretions into the trachea is more important than any other single consideration. Moist gauze placed over the tracheal orifice and a warm room with equable temperature and moist air and change of position from side to side, are the most important indications.

In two of my cases (V and XII) where death occurred with cardiac symptoms, I am of the opinion that perhaps more systematic attention to feeding and stimulation might have tided them over.

The high mortality rate in this series was due, at least to some extent, I believe, to the fact that operation was decided upon in every case entirely from the local conditions, and in several of the cases the general condition of the patient while not so bad as to preclude operation was far from satisfactory. It will be noted that in every one of the fatal cases, there was some serious complicating condition.

CASE V was a feeble old man of 74 years, with very advanced disease.

CASE XII, æt. 56, was a patient who had deferred operation until breathing had become almost impossible. Autopsy showed fatty infiltration and degeneration of the heart and acute myocarditis.

Of the two cases which died of pneumonia, Case IV was a man aged 60 who had been compelled to depend entirely upon the catheter to evacuate his bladder for five years prior to operation, on account of prostatic disease.

CASE VIII, a woman aged 50, had a large cancerous growth in the pharynx and upper portion of the œsophagus which had extended to the larynx. She had suffered great pain and difficulty in both swallowing and breathing for some time before operation and was in an exhausted condition.

CASE VII has already been referred to as having presented herself with an extensive cancer of the œsophagus which had prevented her from swallowing even liquids for seven days prior to operation. She was in an almost moribund condition and should not have been operated upon at all.

CASES X and XI present some points of special interest. In Case X I removed a considerable area of the pharynx with the

retropharyngeal tissues and lymphatic glands.   I then attempted to unite the upper and lower pharyngeal borders at some points, with the hope of securing some continuity of mucous membrane which would protect against contraction and might even perhaps cause some epithelial growth to extend over upon the cicatricial tissue.   The tension was too great and the result was a failure. Contraction of this portion of the pharynx occurred, for which the patient is obliged to wear a tube to keep the passage open sufficiently to enable her to take food.   She takes out the tube at meal times and swallows naturally, but wears it in the intervals.   This is, of course, a serious inconvenience.

In Case XI I was barely able to bring the stump of the œsophagus out and attach it to the skin below and to the side of the tracheal stump.   The removal of pharyngeal tissue was so extensive that there was no possibility of establishing a communication with a continuity of mucous membrane between the mouth and the œsophagus.   This patient fed herself with a tube and got along very well, but has since died from local recurrence.

In conclusion, I desire to express my opinion that complete laryngectomy is an operation which should have almost no essential mortality,—and when diagnosis is made early, which can be so readily done, there should be no recurrence of the disease.   Moreover, the patient's comfort should be greater than after most operations which involve the ablation of an important organ.

I have not had the experience to justify me in comparing total laryngectomy with hemilaryngectomy or thyrotomy for the removal of intralaryngeal cancer, which latter operation has been so highly recommended by English authorities— notably, Mr. Butlin and Sir Felix Semon—but, as a general surgeon, the principle of wide extirpation of the local disease appeals to me very strongly, and the condition of the patient after operation is a much more tolerable one than it is generally thought to be.

THE OPERATIVE TREATMENT OF HEART WOUNDS.

REPORT OF A CASE OF WOUND OF THE RIGHT AURICLE; SUTURE; RECOVERY. TABULATION OF 158 CASES OF SUTURED HEART WOUNDS.

BY CHARLES H. PECK, M.D.,

OF NEW YORK CITY,

Attending Surgeon, French Hospital; Junior Attending Surgeon, Roosevelt Hospital; Adjunct Professor of Clinical Surgery in Columbia University.

ON the evening of June 14, 1908, at about eleven o'clock, a colored girl, 24 years of age, was brought to the Roosevelt Hospital in the ambulance, having been stabbed in the chest with a pocket-knife about 20 to 30 minutes before her arrival at the hospital. I happened to reach the hospital at almost the same moment on a call to another case, and saw the patient in less than five minutes after her admission. The ambulance surgeon and house surgeon had already concurred in a diagnosis of wound of the heart. There was no radial pulse, but a weak pulse varying in force and volume with each inspiration and expiration could be felt high in the brachial artery, and in the carotids. The heart sounds could not be heard. Respiration was faint and shallow, extremities cool, and the patient in profound shock. The area of cardiac dulness was increased but no attempt was made to accurately map it out. The left pulmonary signs were normal. The patient was intoxicated, restless and irritable when aroused, otherwise apathetic. There was a stab wound at the left border of the sternum over the third costal cartilage, which bled very little, and two superficial stab wounds on the right and left breasts respectively, as well as several scars on face, chest and arms, the result of previous battles (see Fig. 1).

The patient was taken at once to the operating room and chloroform and ether anæsthesia commenced, at 11.15 P.M., about 45 minutes after the receipt of the injury. A quadrangular flap with base external, its margins at the second interspace, left half of sternum, and fifth interspace, was rapidly marked out and the soft parts dissected back. A portion of the sixth costal carti-

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lage was excised, the fourth and fifth cut at their sternal attachments, and the third found to have been severed by the stab wound. The internal mammary vessels were ligated above and below, the third, fourth and fifth ribs partly cut through with bone forceps near the costochondral junction to form a hinge and the musculocartilaginous flap carefully lifted, the pleura being pushed away from its deep surface with gauze pads. Except for an accidental tear near the lower portion of the flap, which was covered at once with gauze pads, no opening in the pleura was made. The stab wound in the pericardium, about 1.5 cm. long was so close to the edge of the sternum, that for a good exposure, removal of a portion of the bone with rongeur forceps was necessary. The pericardial wound was apparently closed by clot or the valve-like effect of the intrapericardial tension, and did not bleed, but there was a considerable amount of clot infiltrating the areolar tissue of the anterior mediastinum. Intrapericardial tension was so great that the heart beat could not be felt even with the finger directly on the sac. The pericardium was opened with a 3-inch longitudinal incision, 1 inch to the left of the stab wound, and about 300 c.c. of dark blood escaped with a gush, the anæsthetist noting immediate return of the radial pulse. The degree of "heart tamponade" had been extreme, and had evidently nearly reached the fatal limit of complete arrest of venous return to the auricles.

The bleeding seemed to come from the upper right portion of the pericardial sac, but the rapidly beating heart, churning the free blood, made it impossible to locate the wound until a transverse cut in the pericardium to the right gave a better exposure. Then by lifting the heart forward with the left hand and rotating it slightly to the left, a wound of the right auricle about 1 cm. long and 2 cm. above the auriculoventricular groove, was brought into view. With each systole a stream of dark blood spouted two or three inches. A suture of No. 0 chromicized catgut was passed on a curved intestinal needle and tied, the ends left long, helped to steady the heart while three more similar sutures were inserted—four in all—completely controlling the bleeding. An effort was made to avoid piercing the endocardium, but whether successful or not, in the thin auricular wall, is doubtful. The rapid, tumbling action of the heart made it impossible for me to tell whether the sutures were passed and

tied in systole or diastole. The pericardium was emptied of blood and clot with the hand and gauze sponges, and closed without drainage with continuous sutures of No. 2 chromicized catgut. The musculocartilaginous flap was carefully sutured with No. 3 chromicized catgut, the flap of soft parts, after excising the stab wound, with catgut, silkworm-gut and a continuous silk suture. The suture of the flaps completely closed the accidental tear in the pleura and stopped the sucking in of air. No drainage was used. An intravenous saline infusion of 1200 c.c. was given on the table during the progress of the operation, which lasted 65 minutes. On return to the ward from the operating room, her pulse was 136; respiration, 56; temperature, 99.6. Six hours later another infusion of 900 c.c. was given, as the pulse had become very weak.

For the first six or seven days there were signs of a mild pleurisy (dulness and diminished voice and breathing) in the left chest: temperature ranged from 100 to 102.8; pulse, 116 to 136; respiration, 24 to 36. At the end of the second week the signs had nearly disappeared, and pulse and temperature were approaching the normal. The wound healed by first intention; all sutures were removed on the eighth day; she was allowed out of bed on the seventeenth day and left the hospital well on July 8, 24 days after the operation. Her pulse at that time was 80–96, regular and of good quality. The heart sounds were normal and the signs of pleurisy had disappeared.

Nearly all writers on heart wounds of both clinical and experimental work, have considered wounds of the auricles more dangerous than those of the ventricles, but of the 11 reported cases of auricle wounds operated upon, 7 have recovered and 4 have died—a mortality of 36.3 per cent., while the general mortality of sutured heart wounds is about 64 per cent. Of the 160 tabulated cases there were 69 of the right ventricle with 48 deaths (69.6 per cent.) ; 74 of the left ventricle with 45 deaths (60.8 per cent.) ; 5 of the left auricle with 2 deaths (40 per cent.) ; 6 of the right auricle with 2 deaths (33.3 per cent.) ; and 7 miscellaneous cases with 5 deaths (71.5 per cent.) ; a total of 102 deaths and 58 recoveries (63.7 per cent.).

FIG. 1.
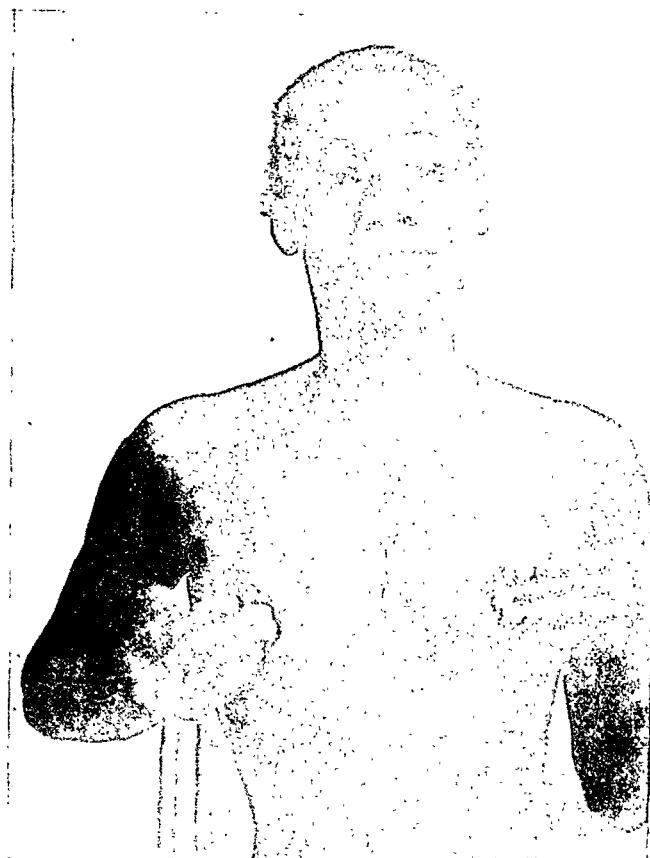
Photograph taken three weeks after operation, showing healed in-
cision and scars of other stab wounds. (Author's case.)

FIG. 2.
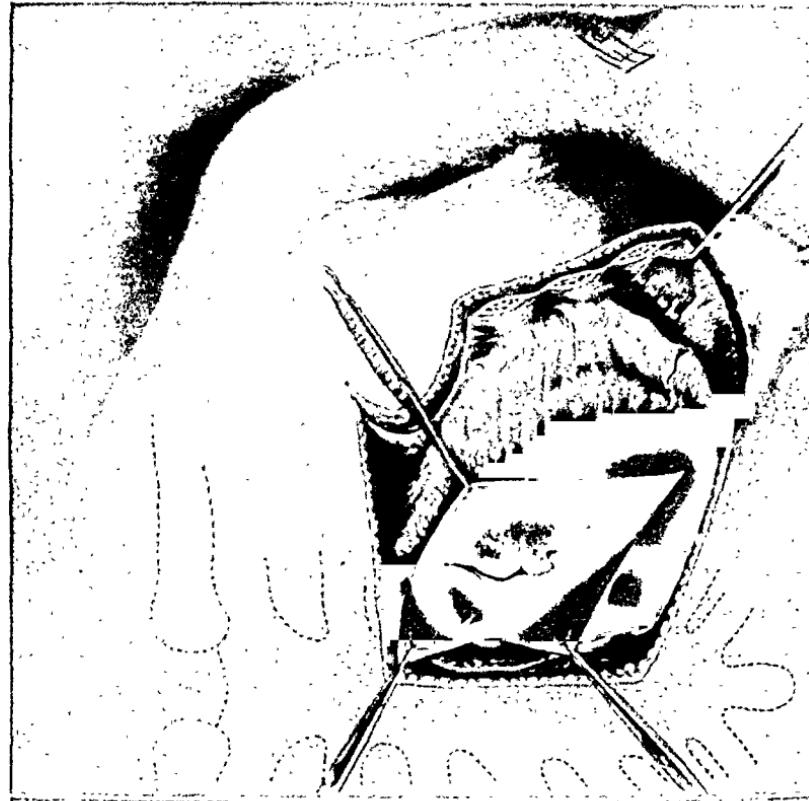
Quadrangular flap of third, fourth, and fifth ribs, hinge external. The drawing represents in addition the removal of part of the sternum, additional transverse incision in pericardium, accidental tear in pleura, and wound of author's case. With care in elevating the flap, the pleura may be pushed back without injury.

FIG. 3.
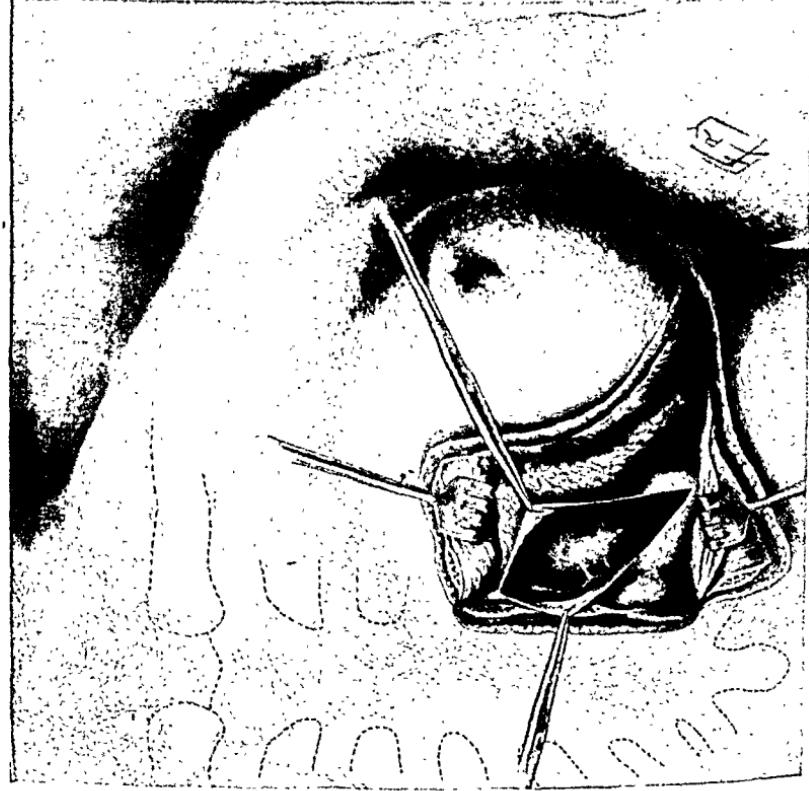
Long intercostal incision in fifth space, with division of fourth, fifth, and sixth cartilages at their sternal attachments, forming two triangular flaps. Pleura freely opened.

Except as regard the auricle wounds these statistics do not vary greatly from those that have been published from time to time during the past nine or ten years, by Giordano, Hill, Rehn, Lenormant, Stewart, Vaughan, and others. In only a comparatively small precentage of all inflicted heart wounds will surgical intervention be possible. In the larger wounds fatal hemorrhage into the pleural cavity or through the external wound usually takes place. In smaller wounds the pericardial opening may be closed by clot or valve-like pressure, producing the so-called "heart tamponade," the intrapericardial pressure preventing the entrance of blood through the great veins in to the auricles, and consequent pumping dry of the ventricles. In this condition it is the mechanical choking or drowning of the heart, and not the loss of blood which determines the fatal issue. Spangaro's [96] conclusions from recent experimental work are that "the consequence of hæmopericardium is to render diastole difficult and aspiration insufficient, whence an important and progressive lessening of blood pressure and weakening of the pulse. For this the hæmopericardium need not be abundant. After removal of blood from the pericardium the pressure augments and the pulse becomes more or less normal."

This has been strikingly shown in many of the cases operated upon, my own included, and has led to the suggestion that preliminary aspiration of the pericardium be made as soon as the case is seen, to give temporary relief while preparation for the operation is being made. Few if any deaths are directly due to the shock of the heart injury. Kronecker and Schmey [51a] claim that there is a point at the junction of the upper and middle thirds of the interventricular groove, where in animals simple puncture is capable of causing immediate and permanent stoppage of the heart's action, and have called this the "co-ordination centre."

Elsberg,[23] in an elaborate series of experiments on animals made in 1899 at Breslau, showed conclusively that the heart in dogs and rabbits is capable of resisting trauma to an astonishing extent, even ligation of the entire heart at the junction

of the lower and middle thirds of the ventricles and amputation through the ventricles below the ligature being followed by recovery of the animal.

Traver's [105] case corroborates the view that the human heart has similar powers of resistance. A boy 19 years of age was impaled on an iron picket fence. The sternum was fractured and the right ventricle wounded, the heart wound being plugged by a fragment of bone. Terrific bleeding through the extensive tear in the heart wall followed removal of the fragment of bone, the hemorrhage being temporarily checked by three fingers passed through the wound into the cavity of the ventricle. Twenty-three stitches (in two tiers) were used in closing the 2¼-inch wound in the ventricular wall, and the patient lived more than ten days, death occurring from slow secondary hemorrhage into the pericardium due to imperfect healing of the contused and lacerated wound edges, and not from sepsis. This was probably the most extensive heart wound ever sutured with even temporary success.

Certain and rapid healing of sutured heart wounds may be definitely counted upon if death from hemorrhage or shock is averted, and septic infection prevented. Elsberg has shown that repair takes place as in other muscles, by the formation of fibrous cicatricial tissue and not by regeneration of heart muscle, but that it is none the less strong, and the function of the heart muscle is not seriously impaired.

The suggestion that wounds of the human heart might be sutured was made by Dr. Roberts of this Association in 1881 and was received with skepticism. Farina [24] of Rome, in 1896, is credited with the first operation, and Rehn [82] of Frankfort in 1897 with the first recovery. In this country Nietert [70] and Vaughan [108] led the way in 1901, and up to the present time 16 cases have been operated upon with 7 recoveries. The 160 tabulated cases have been reported by 121 different operators, no surgeon having reported more than three cases. The rarity of the opportunity and the importance of prompt and definite action make it desirable that every

surgeon to whom such a case may come should be familiar with the best plans of operative procedure, in order that the choice of method may be instantaneous and the steps executed without delay. These steps involve the consideration of:

1. Anæsthesia.
2. Local preparation of the operative field.
3. Choice of method of exposure.
4. Temporary control of hemorrhage while sutures are being placed, and sutures.
5. Stimulation and resuscitation.

Anæsthesia.—Of this little will be said; the need of a general anæsthetic and the method of administration is decided by the operator on general principles, as in other desperate conditions.

Local Preparation of the Operative Field.—As infections have occurred in more than 50 per cent. of all patients who have recovered, and at least 40 to 50 per cent. of the fatal cases, this is a matter of vital importance. It should be done rapidly but thoroughly, while the patient is being anæsthetized, the usual cleansing with soap and water, alcohol, etc., being followed by the application of tincture iodine or Harrington's solution to the entire operative field. The operator should be ready by the time the patient is prepared and anæsthetized, and the whole proceeding should take very few minutes. Excision of the original stab or bullet wound in the soft parts is also important, as some of the infections have undoubtedly originated here.

Choice of Method of Exposure.—The fact that the 158 reported cases have been distributed among 119 different operators helps to explain the diversity of opinion as to the best method of approach, and the many methods which have been employed.

The quadrangular flap with hinge external, including from two to five cartilages has much to commend it (Fig. 2). It has been the favorite method of the French since Fontan's case in 1900. It gives a good exposure, can be rapidly formed with few vessels to control and makes it possible to avoid injury

to the pleura, an important point if hæmopneumothorax is not already present.

A quadrangular flap with hinge internal at the sternal border has been used many times, but gives a less free exposure of the right ventricle and auricle and widely opens the pleura. In a few cases this latter type of flap has included transverse divisions of the sternum at its base, the hinge being made at the junction of the right costal cartilages with the sternum. This procedure endangers the right pleura, injury to which would mean double pneumothorax and death (see Case 127).

A long intercostal incision, usually in the fifth or fourth spaces, to which may be added division of one or more cartilages at their sternal attachments, forming one or two triangular flaps (Fig. 3), is another method advocated of late on account of its simplicity and rapidity of execution. It involves free opening of the pleura, but in many of the cases the pleura has already been wounded and hæmopneumothorax is present. In some cases—tall individuals with wide intercostal spaces—the intercostal incision with strong retraction gives sufficient exposure without cutting rib or cartilage.

The dangers of pleural opening will be greatly diminished if the principle of performing thoracic operations under negative or positive pressure, which is now attracting so much attention in the surgical world, becomes practical and more generally available.

Temporary Control of Hemorrhage While Sutures are Being Placed; Sutures.—After the pericardium is freely opened by enlarging the original wound or by a longitudinal incision, fresh bleeding increased by the relief of intrapericardial tension, may be a serious danger. The heart wound may be large enough to be plugged temporarily by a finger, or rarely more than one, as in Travers' case. Haecker [42a] has recently shown on dogs that compression of the base of the heart between two fingers, completely shutting off return of blood to the auricles, is borne without ill effect about 1½ minutes continuously, and up to 10 minutes with short intermissions. Generally, it has been sufficient to quickly place one or

two sutures to co-apt the edges of the wound enough to partly check the hemorrhage, adding others to complete the control if necessary, more deliberately.

The end of the first suture left long is a great aid in steadying the heart for the placing of others. A separate temporary stitch through the muscle at the apex for this purpose, as advocated by Spangaro, should be unnecessary. Sutures of fine catgut, chromicized catgut, or silk have proven equally efficacious and harmless. A small curved intestinal needle should be used, and the endocardium should not be included in the stitch. Interrupted, continuous or mattress sutures may be used. A slight irregularity of the heart's action may be caused by the first manipulation with the hand or needle puncture, but it is the experience of most observers that this effect it quite transitory and the heart soon recovers its equilibrium.

Stimulation and Resuscitation.—The most effective stimulation is intravenous saline infusion given while the operation is in progress, which has been successfully used in many of the reported cases. Direct heart massage, for cessation of the heart beat, has been employed several times, with apparently benefit in some instances. It should be given a thorough trial before abandoning a case as hopeless, combined, perhaps, with direct infusion into the ventricles.

Wound Closure and Drainage.—A study of the Table shows, excluding 35 cases which died on the table or very soon of hemorrhage or shock, and 13 of unknown causes, that in the remaining 112 it is definitely stated that 67 (60 per cent.) had infections of pericardium or pleura or both, 41 of whom died and 26 recovered. Unquestionably the use of drainage has in some instances favored the development of secondary infections of pleura or pericardium, and I believe that closure of both without drainage, in conjunction with systematic careful preparation on the lines suggested, is, as a rule, the best procedure. If the pleura has contained much blood and has been widely opened, drainage of the pleura alone may be indicated and should preferably be made pos-

CHARLES H. PECK.

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and ... of heart wound
1	Barth......... 1901	Stab wound through ensiform cartilage	Right pleura and tricuspid valve wounded	½ hour	Right vent. 1 c
2	Barth......... 1902	Stab wound 3 cm. within and below left nipple	....	1 hour	Right vent. of cm.
3	Baudit......... 1900	Stab wound in 5th left space, 2.5 cm. within and 1 cm. below left nipple. Male; 23 yrs.	....	1 hour	Right vent. ... intervertne... groove, very small
4	Bayha.. 1908	Stab wound below 5th rib, 2 fingers' breadth from sternum. Male; 24 yrs.	Left pleura filled with blood	2–3 hours	Right vent., middle, transverse. 1 cm.
5	Blake......... 1907	Stab wound through 4th left cartilage, 1 cm. within nipple line. Male; colored	Left pleura contained 2 pints of blood; pericardium about 2 oz.	2½ hours	Right vent. 1 c
6	Borzymowski 1903	Two stab wounds over 4th left cartilage	....	....	Right vent
7	Bougle......... 1901	Pistol-shot wound in 3rd left space, one finger's breadth from sternum	....	½ hour	Right vent. 2 wounds
8	Brenner......... 1900 (report by Zulehner)	Stab wound at border of sternum, level of 6th cartilage. Male; 35 yrs.	Penetrating abdominal wound	More than 24 hours	Right vent. 1 c
9	Bufnoir......... 1899	Pistol-shot wound, 22 caliber, in 5th left space	....	....	Right vent
10	Camus......... 1905	Stab wound in 4th left space, 1 finger's breadth from sternum, 2 cm. in length. Male; 43 yrs.	Left hæmothorax, large amount	1 hour	Right vent 1...
11	Camus 1905	Stab wound in 3rd left space, midway between nipple and sternum. Male; 18 yrs.	Left hæmothorax, large amount. Wound extended into root of pulmonary artery	1 hour	Right vent 1... cm.
12	Capello......... Cimorini 1904	Stab wound through 7th left cartilage, at margin of sternum	Peritoneum wounded	....	Right vent
13	Carnabel......... 1900	Stab wound in 3rd left space, 3 cm. from sternum	....	2 hours	Right vent 1 c

RIGHT VENTRICLE

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
Resection of 5th, 6th and 7th costal cartilages. Chloroform. 4 silk sutures	Drainage	Drainage	Pleuritis	Died on 4th day.
Resection of 5th rib and 6th cartilage. No anæsthetic. 3 sutures	No drainage	No drainage	Pleuritis	Recovered.
Quadrangular flap, hinge external. Pleura freely opened. Chloroform. Wound sutured	No drainage	No drainage	Pleuritis; not drained	Recovered. Patient ran 100 feet after receipt of injury.
Resection of 5th rib and 6th cartilage. Pleura freely opened. Ether and chloroform. 3 sutures, deeply placed	No drainage	Drainage in posterior axillary line; resect 9th rib	Empyema; secondary drainage 14 days after operation	Recovered. Examined 7 months later; heart sounds normal; action regular.
Flap of 3rd, 4th and 5th cartilages, hinge internal. Pleura freely opened. Ether. 3 interrupted silk sutures; 1 mattress suture over them	No drainage	No drainage. Gauze drain in stab wound	Double pneumonia; left empyema, drained on 26th day after operation. Wound infection	Recovered.
Flap of 3rd, 4th and 5th ribs, hinge external. Ether. One wound sutured	....	....	Pericarditis and pleuritis	Died two days later. Two wounds found; only one sutured.
Flap of 3rd, 4th and 5th ribs, hinge external. Chloroform. Both wounds sutured with catgut	No drainage	Drainage	....	Died 5 hours later. Ball had passed through wall of ventricle, not opening cavity.
Resection of 5th, 6th and 7th ribs. Chloroform. Sutures tore out at first. Suture not completed	....	....	....	Died on table. Heart muscle degenerated and friable.
Wound of entrance sutured; wound of exit not sutured	....	....	....	Died.
Flap of ½ width of sternum, 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Anæsthesia. Wound sutured with catgut	Small drain	Gauze drainage	Left pneumonia	Died 22 hours later.
Flap of 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Anæsthesia. Wound sutured with No. o catgut	....	....	....	Died on tabl
Resection of 4th, 5th, 6th and 7th cartilages. No anæsthetic. 8 sutures	Drainage	....	Suppurative pericarditis; heart sutures discharged in pus on 15th day. Subphrenic abscess	Died 2 months later.
Resection of 4th and 5th cartilages. Ether. 3 catgut sutures	Drainage	Drainage	Pericarditis and pleuritis	Died 4 days later.

CHARLES H. PECK.

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
14	CHASTENET DE GERY...... 1908	Horizontal stab wound 5 cm. long in 3rd left space. 1½ cm. from sternum. Male; 24 yrs.	Left pleura full of blood; interventric; septum wounded	3 hours	Right vent. Near intervent. groove. 1 cm.
15	DOLCETTI........ 1906	Stab wound in 5th left space within nipple line	....	1 hour	Right vent. 1½ cm.
16	FARINA.......... 1896	Stab wound at upper border of 6th left rib near sternum	....	....	Right vent. 6 mm.
17	GAUDEMET....... 1905	Stab wound in 5th left space, 5 cm. from median line	Hæmopericardium, 200 c.c.	1¼ hours	Right vent, near auricle, 4 mm.
18	GENTIL.......... 1904	....	....	....	Right vent.
19	GERZEN.......... 1902	Stab wound below left costal arch	....	....	Right vent. 2½ cm.
20	GIBBON.......... 1902	Stab wound through 4th costal cartilage. Male; colored; 25 yrs.	No wound of pleura	1 hour	Right vent. 1½ cm.
21	GIBBON.......... 1905	Stab wound through 4th costal cartilage	Pleura not wounded	2 hours	Right vent. near auriculovent. groove, ⅓ in.
22	GIUDICE......... 1905	Stab wound in 3rd left space	....	Soon	Right vent. 1 cm.
23	GRASSMAN....... 1908	Stab wound in 4th space, 1 cm. from border of sternum. Male; 14 yrs.	Left hæmothorax, 1½ liters. Hæmopericardium, large amount	3¾ hours	Right vent. 1½ cm.
24	GRASSMAN....... 1908	Stab wound in 4th space, 2 cm. from sternum. Male; 30 yrs.	Left hæmothorax, 1½ liters, very little hæmopericardium	½–1 hour	Right vent. transverse 3 cm.
25	GREKOW AND ZEIDLER..... 1903	Stab wound outside left nipple	....	5 hours	Right vent. near apex. 1.5 cm.
26	GREKOW AND ZEIDLER....... 1903	Stab wound in 2nd left space	....	4¼ hours	Right vent. 1½ cm.
27	GUENOT.......... 1905	Stab wound in 2nd right space, 2 cm. from sternum. Male; 32 yrs.	Right hæmopneumothorax; 1½ litres of blood	1 hour	Right vent. 1 cm.

RIGHT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Results and remarks.
	Pericardium	Pleura		
Flap of 3rd and 4th ribs, hinge external. No anæsthetic. Several catgut sutures	....	....	....	Died on table; heart massage continued for 35 to 40 minutes without effect.
Resection of 4th and 5th cartilages. Eucain analgesia. 3 silk sutures	No drainage	Drainage	Peritonitis and mediastinitis	Died 7 days later; Heart stopped during operation and was revived by massage.
Resection of 5th, 6th and 7th cartilages. Chloroform. 3 silk sutures	No drainage	....	Bronchopneumonia	Died 5 days later of pneumonia. Heart wound found healed at autopsy.
Flap of 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Chloroform. 3 catgut sutures	Drainage	Posterior drainage in 8th space	....	Died 24 hours later. Clot found in tricuspid valve, probably the cause of death.
Flap of ribs, hinge external	....	....	Pericarditis. Syphilis	Died 17 hours later.
Resection of 5th, 6th, 7th, 8th and 9th cartilages. Pleura not opened. Chloroform. 4 sutures	Drainage	....	Pericarditis and pleuritis	Died 23 days later.
Skin flap; excision of 3rd and 4th cartilages. Chloroform. 1 catgut suture	....	....	....	Died on table.
Resection of 4th rib and cartilage. Ether. 4 chromic catgut sutures	Gauze drain	No drainage	....	Recovered.
Resection of 4th and 5th cartilages. Catgut sutures	Drainage	Drainage	....	Died next day from effects of hemorrhage.
Resection of 4th and 5th cartilages. Pleura freely opened. Chloroform. 5 silk sutures	No drainage	No drainage	Nonsuppurative pericarditis and pleuritis. Superficial abscess in wound	Recovered.
Resection of 4th and 5th cartilages. Pleura freely opened. No anæsthetic. 4 silk sutures	....	....	....	Died on table. Heart massage and direct infusion into ventricle without result
Resection of 3rd, 4th and 5th ribs. Chloroform. 2 silk sutures	No drainage	Drainage	Pericarditis and pleuritis	Died 60 hours later.
Resection of 3rd, 4th, 5th and 6th ribs. Chloroform. 5 silk sutures	No drainage	No drainage	Pericarditis and pleuritis	Died 13 days later.
Flap of 3rd, 4th, 5th and 6th right ribs, hinge external on right. Right pleura freely opened. Chloroform. 3 catgut sutures	No drainage	No drainage	Hemorrhage of 700 Gm. from a parietal vessel, into right pleura, after operation	Died 28 hours later. Infusion of 5 liters saline solution given during operation.

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and of heart wound
28	HESSE.......... 1905	Scissors wounds in 4th and 5th left spaces. Male; 25 yrs.	Left hæmothorax, large amount	¾ hour	Right vent. apex. 1 cm.
29	HORODYNSKI..... 1899	Stab wound in 3rd left space, 2 cm. from sternum. Female; 23 yrs.	Pleura and lung wounded, left hæmopneumothorax	1 hour	Right vent. low third
30	ISNARDI AND COLOMBINO...... 1902	Stab wound in sternum at articulation of 5th left costal cartilage	....	2 hours	Right vent. 1 cm.
31	KOSINSKI........ 1899	Stab wound in 3rd left space	....	....	Right vent.
32	LASTARIA........ 1901	Stab wound in 5th left space, at border of sternum	....	¼ hour	Right vent.
33	LEMAITRE....... 1904	Poniard stab wound in 5th left space, near sternum. Male; 20 yrs.	Injury of diaphragm and left lobe of liver	1 hour	Right vent.
34	LENORMANT...... 1905	Pistol-shot wound in 5th left space, at border of sternum. Male; 16 yrs.	Liver, stomach and intestine wounded	7 hours	Right vent. 15 20 mm.
35	LISANTE.......... 1899	Stab wound in 4th space, 1 cm. within nipple line	....	Very soon	Right vent.
36	LISCIA.......... 1901	Stab wound in 4th left space	....	....	Right vent.
37	MANTEUFFEL..... 1903	Pistol-shot wound, 5. mm. in 4th left space	....	9 hours	Right vent. 5
38	MARION........ 1898	Pistol-shot wound in 4th left space, 3 cm. from sternum. Male; 55 yrs.	Pericardium distended with blood	2 hours	Right vent. forated
39	MIGNON ET SIEUR 1901	Stab wound in 4th left space, 2 fingers' breadth from nipple	Large amount of blood in pericardium	1 hour	Right vent. 1 cm.
40	MILESI.......... 1902	Stab wound in 5th left space.	....	2 hours	Right vent. 1 cm.
41	MILESI.......... 1903	Stab wound in 4th left space near sternum	....	1 hour	Right vent. 1

GHT VENTRICLE—*Continued*

erative procedure. An-æsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks.
	Pericardium	Pleura		
p of 3rd and 4th ribs, inge internal. Chloroform. silk sutures.	Drainage	Drainage	Pericarditis and pleuritis	Recovered.
ection of 3rd, 4th and 5th artilages. Pleura freely pened. No anæsthetic. deep and 2 superficial atures	Drainage	Drainage	Pericarditis; double empyema	Died 3 weeks later of empyema.
ection of 5th and 6th ribs, hloroform. 3 sutures	....	Drainage	Empyema; subsequent drainage	Recovered.
utures	....	....	....	Recovered.
p of 3rd, 4th, 5th and 6th artilages, hinge internal. hloroform. Silk sutures	....	Drainage	....	Died next day.
p of 3rd, 4th and 5th ribs, inge external. Slight accidental tear in pleura. hloroform. 3 catgut atures	No drainage	Drainage	Empyema	Died 10 days later.
p of 4th, 5th and 6th ribs, inge external. Chloroform. silk sutures	Drainage	....	Syncope on table; heart massage and traction on tongue revived patient	Died 4½ hours later.
p of 4th and 5th ribs, inge above. Chloroform. ilk sutures	No drainage	....	Signs of cardiac aneurism at end of 2 months	Recovered.
p of 2nd, 3rd, 4th and 5th bs. No anæsthetic. 3 atures	....	....	Pleuritis; nephritis	Died 42 hours later.
ection of 4th, 5th, 6th and th cartilages. Ether. Silk atures for both wounds	No drainage	Drainage	Pericarditis: pericardium aspirated 2 days after operation	Recovered. Bullet perforated anterior wall and lodged in posterior wall where it could be felt. Incision and extraction of bullet.
ection of 6th and 7th cartilages and part of sternum. ther. Wound of entrance atured	....	....	....	Died on table.
ection of 4th, 5th and 6th artilages. Pleura not pened. Silk sutures	Drainage	Drainage	....	Died 2 hours later. Suicide during course of a grippe pneumonia.
ection of 6th rib. Chloroorm. 4 silk sutures; 1 eep and 3 superficial	Drainage	Drainage	....	Died 15 hours later; hemorrhage.
ection of 4th cartilage. hloroform. 3 silk sutures, deep and 2 superficial	No drainage	Drainage	Pericarditis	Died 7 days later.

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and sir of heart wound
42	MORESTIN 1903	Pistol-shot wound, 8 mm., through sternum opposite 4th costal cartilage. Male; 20 yrs.	....	21 hours	Right vent., cc wound
43	MUSUMECI....... 1905	Stab wounds in 4th and 5th left spaces	Three intestinal wounds	Soon	Right vent.
44	NANU.......... 1900	Stab wounds in 3rd left space, 4 cm. from sternum	Pleura wounded	2 hours	Right vent. nea apex, 2 cm.
45	NEUMANN 1905	Stab wound below left costal arch in parasternal line. Male; 53 yrs.	....	....	Right vent. a mitted fore finger
46	NICOLAI 1899	Stab wound in 4th left space, parasternal line	....	1½ hours	Right vent. nea apex
47	NIETERT......... 1901	Stab wound in 5th right space, at border of sternum. Male; 22 yrs.	Pleura not wounded	2 hours	Right vent. ½ inc
48	NIMIER.......... 1905	Stab wound in 4th left space, 1 cm. from sternum. Male; 26 yrs.	....	25 min.	Right vent.1.5 c
49	PECORI.......... 1903	Stab wound in 5th left space, within nipple line	....	....	Right vent.
50	RAMONI 1899	Stab wound over 5th left cartilage, 2 cm. from sternum	....	½ hour	Right vent. 2 wounds
51	REHN.......... 1897	Stab wound in 4th left space, 2 cm. from sternum. Male; 22 yrs.	Left hæmothorax, large amount	More than 24 hours	Right vent. 15 cm.
52	REHN.......... 1906	Stab wound in 4th left space; fell on knife. Male; 30 yrs.	....	8½ hours	Right vent.
53	RICHE.......... 1902	Stab wound in 4th left space, parasternal line. Female; 30 yrs.	....	2 hours	Right vent. 5 cm
54	SAVARIAUD....... 1902	Stab wound in 5th left space, 3 cm. from sternum	Border of lung wounded	....	Right vent near apex
55	SAVARIAUD....... 1904	Stab wound below and internal to left nipple. Female; 35 yrs.	....	2½ hours	Right vent.

RIGHT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks.
	Pericardium	Pleura		
Resection through sternum. Chloroform. 4 catgut sutures	Drainage	Drainage	....	Died 19 hours later of embolism (?). Bullet found in cavity of right ventricle.
Flap; hinge internal. Ether and chloroform. Suture of heart and intestinal wounds	No drainage	....	....	Died 18 hours later.
Resection of 2nd, 3rd and 4th cartilages. 3 catgut sutures	No drainage	Drainage	Pericarditis and pleuritis	Died 4 days later.
Resection of 4th, 5th, 6th and 7th cartilages. Sutures tore out at first	Gauze tampon for hemorrhage	....		Died ¾ hours later; hemorrhage.
Resection of 4th and 5th cartilages. Anæsthetic. Wound sutured	....	....	....	Died 12 hours later.
Skin flap, base to left; partial resection of sternum. Pleura not opened. No anæsthetic. 3 silk sutures	....	....	Pericarditis	Died 33 hours later from pericarditis.
Flap of 4th, 5th and 6th ribs, hinge external. Pleura not opened. Chloroform. 4 catgut sutures	Drainage	Drainage	....	Died next day.
Flap of 5th and 6th ribs. Sutured; first sutures tore out	....	....	....	Died on table; hemorrhage.
Flap of 4th and 5th ribs hinge below. Chloroform. 4 sutures in one wound, 2 sutures in the other	....	Drainage	....	Recovered.
Resection of 5th cartilage. Chloroform. Silk sutures	Drainage	Drainage	Empyema; secondary drainage	Recovered.
Flap of 4th and 5th ribs, hinge internal. Pleura freely opened. Chloroform and ether. 10 silk sutures	No drainage	No drainage	Pleuritis; 900 c.c. of fluid aspirated from left chest the day after operation	Died 2 days later.
Flap of 3rd and 4th ribs, hinge external. Pleura freely opened. Chloroform. Wound sutured	No drainage	No drainage	No postoperative complications	Recovered.
Flap of 4th and 5th ribs, hinge external; pleura not opened. Chloroform. 3 sutures	....	....	Gangrene of border of lung	Died 52 hours later.
Flap of 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Chloroform. 3 catgut sutures	No drainage	No drainage	Pericarditis; pyopneumothorax	Died 14 days later.

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and site of heart wound
56	SCHACHOWSKI..... 1903	Stab wound in 6th left space, near nipple line	....	....	Right vent. 1½ cm.
57	SMITH........... 1904	Stab wound in 4th left space, 2 cm. from sternum. Male; colored; 22 yrs.	....	½ hour	Right vent.
58	SOAVE........... 1907	Stab wound in 5th left space, 4 fingers' breadth from sternum. Male; 19 yrs.	....	Very soon	Right vent.
59	STEYNER........ 1903	Stab wound at about 5th rib near sternum	....	....	Right vent.
60	THIEMANN....... 1906	Needle fixed at border of 4th rib, 31 mm. in tissues. Male; 23 yrs.	Wound of pleura; slight hæmoperi-cardium, 100 c.c.	4 hours	Right vent. 1 cm. and right aur. 1.5 cm.
61	TRAVERS....... 1906	Impaled on iron pick-et; wound through lower end of ster-num. Male; 19 yrs.	Comminuted fracture of sternum	3 hours	Right vent. 1-1 wound; 2½ inch
62	VAUGHAN....... 1908	Stab wound in 4th left space, near nipple. Male; colored; 32 yrs.	Left lung and pleura wounded hæmo-thorax, 1 pint	1 hour	Right vent, low part, ⅓ inch
63	VOGEL.......... 1903	Stab wound in 4th left space, near sternum. Male; 16 yrs.	....	At once	Right vent 1½" 2 cm.
64	WALCKER........ 1900	Stab wound below left costal arch in para-sternal line. Male; 53 yrs.	Wound of diaphragm and peritoneum	....	Right vent.
65	WATTEN......... 1900	Stab wound in 4th right space, near sternum	....	6 hours	Right vent 1 cm.
66	WATTS.......... 1908	Stab wound in 2nd left space, near sternum.	....	½ hour	Right vent. at root of pulmo-nary artery
67	WEISS.......... 1904	Stab wound	....	8 hours	Right vent.
68	WOLFF.......... 1903	Stab wound. Male	....	Soon after injury	Right vent 1 cm.
69	DE ZAWADSKI..... 1907	Stab wound	....	....	Right vent

GHT VENTRICLE—*Continued*

erative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks.
	Pericardium	Pleura		
section of 5th and 6th cartilages. 6 sutures	Drainage	. . . .	. . . .	Recovered.
section of 4th and 5th ribs and part of sternum. Ether. Continuous silk sutures	No drainage	Drainage	Pericarditis	Died 7 days later.
.p of 4th and 5th ribs, hinge internal. Chloroform. Silk sutures	Drainage	. . . .	No postoperative complications	Recovered.
section of 4th and 5th ribs. Chloroform. 4 sutures	Drainage	Drainage	. . . .	Recovered.
section of 4th and 5th ribs. Chloroform. 1 catgut suture n ventricle, 4 catgut sutures .n auricle	Drainage	Drainage	Pericarditis. Left pleuritis and empyema	Recovered.
.p of 3rd, 4th and 5th cartilages and part of sternum; hinge below. Chloroform. 23 sutures in 3 rows.	Drainage	Drainage	No sepsis; death due to clot in pericardium from slow secondary hemorrhage	Died on 11th day after operation.
.p of 4th, 5th and 6th cartilages, hinge internal. Pleura freely opened. Ether. 12 silk sutures in 2 rows	No drainage	No drainage	Delirium tremens	Recovered.
section of 4th and 5th cartilages. Chloroform. 5 silk sutures	No drainage	Drainage	Pericardium opened and drained on 2nd day; heart sutures finally expelled	Recovered.
section of 4th, 5th, 6th and 7th cartilages: Peritoneum opened. Sutured; stitch tore out	Wound packed with gauze	. . . .	. . . .	Died ¾ hour later.
ap of 3rd and 4th right cartilages, hinge external, (to the right). Chloroform. 3 sutures	Drainage	Drainage	. . . .	Recovered.
section of 2nd and 3rd ribs. Ether. Sutured.	No drainage	Drainage	. . . .	Died one month later.
section of ribs, laparotomy Sutured	. . . .	Drainage	Pleuritis	Died 15 days later.
tercostal incision in 4th space. 3 continuous silk sutures	No drainage	No drainage	Pericarditis and pleuritis, Thoracotomy on 5th day for empyema	Died 14 days later.
eart wound sutured	. . . .	. . . .	Pneumonia	Died 17 hours later of pneumonia

TABLE II—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
70	ALVEZ DE LIMA.. 1905	Stab wound over 4th left cartilage	Mitral valves wounded	Soon	Left vent. 1½ cm
71	BARTH.......... 1901	3 stab wounds in 4th left space, 3 cm. from sternum. Male; 28 yrs.	....	¾ hour	Left vent. 0.5 cm.
72	BARDENHEUER... 1904 (?)	Gunshot wound	Interventricular septum penetrated; hemorrhage profuse	....	Left vent.
73	BORCHARDT...... 1904	Impaled on picket fence, fell from tree. Male; 12 yrs.	Hæmopneumothorax Abdominal injury suspected	2½ hours	Left vent. posterior wall 1 cm.
74	BORZYMOWSKI ... 1903	Stab wound between ensiform and left cartilages. Male; 22 yrs.	....	....	Left vent. apex 2 cm.
75	BRACHINI........ 1901	3 stab wounds in region of heart. Male; 27 yrs.	....	At once	Left vent wounds. One cm., penetrating. One 3 cm
76	BREZARD AND MOREL........	Pistol-shot wound, 8 mm. in 3rd left space, 2 cm. from sternum. Male; 19 yrs.	Wound of lung. Hæmopericardium, 100 c.c.	Soon	Left vent wounds. f not opened
77	CAPPELEN 1896	Stab wound in 4th left space, midaxillary line	Pericardium distended with blood. Hæmothorax, 1400 c.c. lung compressed. Coronary artery found cut	1 hour	Left vent. 2 cm.
78	CARMELO........ 1904	Stab wound in 4th left space	....	....	Left vent.
79	DUVAL.......... 1906	Stab wound in 5th left space, 8 to 10 cm. from border of sternum. Male; 40 yrs.	Coronary vessels injured	Not known, found unconscious	Left vent. 1.5 cm
80	FISCHER......... 1907	Stab wound in 3rd left space; another over 2nd rib. Male; 45 yrs.	....	1 hour	Left vent.
81	FITTIG.......... 1908	Pistol-shot wound in 3rd left space, internal to nipple. Male; 29 yrs.	Border of lung wounded; sutured	2 hours	Left vent wounds. g and post. 3 c and 1 cm.

EFT VENTRICLE

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
ap of 3rd and 4th ribs, hinge external. Chloroform. 1 catgut suture	No drainage	Drainage	....	Died one hour later; hemorrhage. Heart stopped twice during operation and was revived by massage.
ap of 4th and 5th cartilages, and sternum, hinge on the right. Chloroform. 3 silk sutures	No drainage	Drainage	....	Recovered.
tured	....	....	Pericarditis; septic pleuritis	Died ten days later.
cision over 5th rib from sternum to axilla. Exploratory laparotomy. 4 silk sutures	Drainage	Drainage	....	Recovered.
ound enlarged, resection of 4th, 5th and 6th ribs. No anæsthetic. 3 deep and 3 superficial sutures	....	....	Suppurative pericarditis and pleuritis	Died 2 days later.
p of 3rd, 4th and 5th ribs, hinge internal. No anæsthetic. Penetrating wound closed by 2 sutures	....	....	....	Died on table.
p of 3rd, 4th and 5th ribs, hinge external. Chloroform. Both wounds sutured with catgut	No drainage	....	....	Died on table from hemorrhage. Heart massage tried ineffectually.
section of 3rd and 4th cartilages. Ether. Sutured	....	....	Pericarditis	Died 3 days later of pericarditis.
section of 4th and 5th cartilages. Chloroform. Silk sutures	....	Drainage	Bronchopneumonia	Died 3 days later.
p of 4th, 5th and 6th ribs, nge external. Pleura ely opened. No anæsthetic. 2 interrupted sutures	....	....	....	Died on table. Direct infusion of warm salt solution into ventricle after heart had stopped, revived it for a short time.
und enlarged; excision of d and 4th cartilages. ther. 3 silk sutures	Drainage	Drainage	Pericarditis	Died 30 hours later.
ostal incision in 4th e; resection of 4th and ribs. 6 catgut sutures nterior wound	Gauge drain	Large drain	....	Died 24 hours later; anæmia. Wound of exit did not bleed; not sutured.

CHARLES H. PECK.

TABLE II—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
82	FONTAN......... 1900	Six scissors wounds between 3rd and 7th left ribs. Male; soldier	....	6½ hours	Left vent. 11 cm
83	FONTAN......... 1901	Stab wound in 4th left space, 0.5 cm. outside nipple. Male; soldier	....	2 hours	Left vent 8 mm
84	de FOURMESTRAUX 1905	Stab wound—finger's breadth outside left nipple. Male; 24 yrs.	Hæmothorax, large amount, hæmopericardium, 300 c.c.	½ hour	Left vent. 5-6 above apex
85	de FOURMESTRAUX 1905	Stab wound in 4th left space. Male; 23 yrs.	....	10 minutes	Left vent. extending to right vent. 3 cm.
86	FUMMI......... 1898	Stab wound below left nipple	Pericardium distended with blood. Extensive hæmothorax	Some hours	Left vent, apex Non-penetrating
87	GENTIL.......... 1901	3 stab wounds in 4th left space	....	10 hours	Left vent. 1 cm
88	GERZEN......... 1902	Stab wound in 5th left space	....	....	Left vent.
89	GIORDANO....... 1902	Stab wound in 6th left space	....	....	Left vent. 2 cm
90	GIORDANO....... 1902	Stab wound in 3rd, 4th and 5th left spaces, near nipple	....	....	Left vent. 2 cm
91	GOEBELL........ 1906	Pistol-shot wound, 7 mm. in 3rd left space, 2 cm. from sternum. Male; 23 yrs.	Hæmothorax, large amount. Hæmopericardium, 100 c.c. Lung wounded; sutured with catgut	1 hour	Left vent. 2 wounds. 1 cm
92	GREKOW AND ZEIDLER 1903	Stab wound in 2d left space, 5 cm. from sternum. Male; 25 yrs.	Hæmopneumothorax	3 hours	Left vent. 0.5 cm
93	GUENOT......... 1904	Stab wound in 4th left space. Female; 20 yrs.	Hæmothorax, 1½ liters	1½ hours	Left vent. at apex. 1.5 cm
94	GUINARD........ 1904	Stab wound in 4th left space, within nipple line	Hæmothorax, large amount	1½ hours	Left vent.
95	HENRIKSEN...... 1902	Stab wound in 3d left space, 2.5 cm. from sternum	....	....	Left vent. 1.5
96	HESSE.......... 1905	Stab wound in 4th left space, near sternum. Male; 13 yrs.	Hæmothorax, large amount	¾ hour	Left vent. 1 cm

LEFT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
Flap of 4th, 5th and 6th ribs, hinge external. Chloroform. Continuous catgut sutures	No drainage	No drainage	Pleuritis·	Recovered.
Flap of 4th, 5th, and 6th ribs hinge external. Chloroform. Continuous catgut sutures	No drainage	No drainage	Pleuritis; emboli in right lung	Died 5 months later from brain abscess.
Flap of 3rd, 4th and 5th ribs, hinge internal. Pleura freely opened. 3 silk sutures	No drainage	No drainage	Pleuritis; secondary drainage 6 days later	Recovered.
Flap of 3rd, 4th and 5th ribs, hinge internal. Pleura freely opened. Chloroform. 3 silk sutures	....	....	....	Died on table. Autopsy showed a wound of interventricular septum.
Resection of 5th rib. Anæsthesia. 1 suture.	....	....	Empyema	Recovered.
Flap of 4th and 5th cartilages, hinge internal. Chloroform. Silk sutures	Drainage	Drainage	....	Died 5 days later.
Resection of 5th and 6th ribs. Chloroform. Sutured	No drainage	Drainage	Pericarditis; pleuritis; nephritis	Died 53 days later.
Flap of 4th and 5th ribs, hinge internal. 2 silk sutures	No drainage	Drainage	....	Died 1½ hours later.
Flap of 4th and 5th ribs, hinge external. 2 silk sutures	No drainage	Drainage	Autoplastic operation required to close opening	Recovered.
Flap of 3rd to 7th ribs, hinge external. 9 catgut sutures, 4 in one wound, 5 in the other	Small gauze drain	Gauze drain at lower angle of flap	No complications	Recovered.
Resection of 3rd and 4th ribs. Pleura freely opened. Chloroform. Silk sutures	No drainage	No drainage	Pleuritis, mild	Recovered. Well 10 months later.
Flap of 3rd, 4th, 5th and 6th ribs, hinge internal. Pleura freely opened. Ether. 3 catgut sutures	No drainage	Drainage	Pleuritis	Died 53 hours later.
Flap of 3rd, 4th, 5th and 6th ribs, hinge external. Pleura freely opened. Chloroform. Catgut sutures	No drainage	Drainage	....	Died 18 hours later.
Resection of 3rd and 4th ribs. Sutured	....	....	....	Died 16 hours later.
Flap of 3rd and 4th ribs, hinge internal. Pleura freely opened. Chloroform. 3 silk sutures	Drainage	Drainage posteriorly by resection of rib	Pericarditis and pleuritis	Recovered.

TABLE II—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age.	Complicating injuries	Time between wounding and operation	Position and size of heart wound
97	HILL.............. 1902	Male; colored, 13 yrs.	Hæmopericardium, 10 oz.	....	Left vent. near apex, ¼ inch.
98	JANARI......... 1903	Stab wound in 3d left space	Hæmopericardium; heart tamponade	1 hour	Left vent. 1 cm.
99	LAUNAY 1901	Pistol-shot wound, 7 mm. 1 at left nipple. Male; 26 yrs.	Hæmothorax, large amount. Lung wounded	4 hours	Left vent. 1 wounds, entry and exit
100	LEMAITRE...... 1903	Stab wound in 4th left space, below and internal to nipple. Male; 40 yrs.	Hæmothorax, large amount	1½ hours	Left vent. 4 cm.
101	LONGO......... 1899	Stab wound in 5th left space, 1 cm. outside nipple	....	½ hour	Left vent.
102	MALIZEWSKI..... 1899	Stab wound in 5th left space, in nipple line. Male; young laborer	Wound of pleura and lung; hæmothorax	¼ hour	Left vent. near apex, 2¼ cm.
103	MALIZEWSKI..... 1899	Stab wound in 3d left space, outside nipple line. Male; 24 yrs.	Hæmopneumothorax	¼ hour	Left vent. 1 cm.
104	MASELLI......... 1900	Stab wound through 6th rib, below and within left nipple	....	1½ hours	Left vent. near apex
105	MUSUMECI....... 1908	Stab wound in 5th left space, internal to nipple line. Male; 18 yrs.	....	Not stated	Left vent. near apex, 1 cm.
106	NIETÈRT......... 1901	Stab wound in 6th left space, inside nipple line. Male; colored, 27 yrs.	Hæmothorax, 1½ pint	14½ hours	Left vent. admitting finger
107	NINNI.......... 1898	Stab wound in 5th left space	....	At once	Left vent. admitting finger
108	NOLL............ 1903	Pistol-shot wound in 1st left space, 7 mm.	....	1½ hours	Left vent.
109	PAGENSTECHER .. 1899	Stab wound below and within left nipple	....	16 hours	Left vent. 3.5 cm.
110	PARLAVECCHIO ... 1898	Stab wound in 5th left space	....	8 hours	Left vent. near apex, 3.5 cm.
111	PAROZZANI....... 1897	Stab wound in 7th left space, in nipple line	Left pleura filled with blood	5 hours	Left vent. near apex, 2 cm.
112	PAROZZANI 1897	Stab wound in 3d left space	Wound of interventricular septum	1½ hours	Left vent. 1.5 cm.

LEFT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
...lap of 3rd, 4th and 5th ribs, hinge internal	....	....	....	Recovered.
lap of 3rd, 4th and 5th ribs, hinge internal, Chloroform. Sutured	Drainage	Drainage	Pleuritis	Died 3 days later.
lap of 4th, 5th and 6th ribs, hinge external, Pleura freely opened. Chloroform. Both wounds closed with catgut sutures	Drainage	Drainage	....	Recovered.
lap of 3rd, 4th and 5th ribs, hinge external, Pleura freely opened. Chloroform, 5 catgut sutures	No drainage	Drainage. 2 large drains	....	Died 9 hours later of hemorrhage and shock.
lap of 4th and 5th ribs, hinge above. None. 3 silk sutures	....	....	....	Died on table.
esection of 4th, 5th and 6th ribs. None. 3 silk sutures	No drainage	Gauze drainage	....	Died 26 hours later.
esection of 3rd rib. None. 3 silk sutures	Gauze drainage	Gauze drainage	Purulent pericarditis. Pleuritis	Died 4 days later from purulent pericarditis
esection of 6th rib. No anæsthetic. 2 sutures	No drainage	Gauze drainage	....	Died 12 hours later.
iangular flap turned downward, cutting 5th and 6th cartilages. Pleura freely opened. Ether and chloroform. Silk sutures	Gauze drainage	Drainage	Purulent pericarditis. Pleuritis	Died 12 days later from secondary hemorrhage, due to suppuration in myocardium.
ap of 5th and 6th ribs, hinge ... ...tures	Drainage	Drainage	Empyema; thoracotomy 24 days later. Infection of wound	Recovered.
ap of 4th and 5th ribs, hinge internal. No anæsthetic. 3 sutures	....	....	....	Died on table.
...tured	Drainage	Drainage	Pleuritis	Recovered.
section of 5th cartilage. Ether. 3 deep and 1 superficial suture	No drainage	Drainage	Pleuritis	Recovered.
section of 5th rib. Chloroform. 4 sutures	No drainage	No drainage	....	Recovered.
p of 5th, 6th, 7th and 8th rtilages, hinge internal. o anæsthetic. 4 silk tures	No drainage	No drainage	No complications	Recovered.
p of 4th, 5th and 6th ribs, inge internal. No anæsthetic. 2 sutures	No drainage	No drainage	....	Died 48 hours after.

TABLE II—WOUNDS OF

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and ... of heart wou...
113	Picone.......... 1904.	Stab wound 2 fingers' breadth below left nipple	....	Very soon	Left vent.
114	Pomara......... 1902	Stab wound in 6th left space below nipple	....	....	Left vent. ... apex
115	Quenu.......... 1906	Stab wound in 3d left space, near sternum. Female; 19 yrs.	Pericardium distended with blood. Only a little blood in pleura	2½ hours	Left vent., ... part
116	Renon.......... 1902	Stab wound in 4th left space, 4 cm. internal to nipple. Male; 23 yrs.	Hæmopericardium; large amount	½-1 hour	Left vent. ...
117	Ribas y Ribas... 1905	Stab wound in 3d left space, 3 cm. from sternum	....	About 1 hour	Left vent. 1·
118	Richi:.......... 1904	Pistol shot wound, 8 mm. 5 cm. within and 2 cm. below left nipple. Male; 24 yrs.	Wound of diaphragm, spleen and lung. Very extensive hæmothorax	1½ hours	Left vent. ? wounds
119	Rosa............ 1899	Stab wound in 5th left space	Wound of lung	At once	Left vent. base. 1.5 ..
120	Rothfuchs...... 1905	Bullet wound. Male; 25 yrs.	Wound of stomach and diaphragm. Hæmopneumothorax	....	Left vent. ... forated
121	Senni.......... 1905	Stab wound in 6th left space, in nipple line	....	....	Left vent. 3 ..
122	Somerville 1904	Stab wounds in 4th and 5th left spaces within nipple line. Male	Hæmopneumothorax	55 minutes	Left vent. ... wound ½ ...
123	Stewart, F. T. 1902	Stab wound in 4th left space, ½ inch from sternum	....	Immediately	Left vent. ½
124	Stewart, F. T. .. 1904	Stab wound in 2d left space, 1 inch from sternum. Male, colored; 20 yrs.	Coronary artery injured during suture. Edge of lung wounded	¾ hour	Left vent. ½
125	Stewart, G. D... 1902	Stab wound in 5th left space, ½ in. outside nipple	....	1½ hours	Left vent. ½
126	Stude.......... 1904	Stab wound in chest. Male	....	2 hours	Left vent. 1½ ..
127	Sultan, C....... 1905	2 stab wounds in 5th left space, 2 cm. within nipple line	Hæmothorax. 1 liter. Wound of right ventricle found at autopsy	....	Left vent. ? ..

⌐:FT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
..p of 3rd, 4th and 5th ribs, ⌐inge internal. Sutured	Drainage	Drainage	Hemorrhage into right pleura	Died 2 days later.
section of 5th and 6th ribs. No anæsthetic. Silk sutures	No drainage	Drainage	Pericarditis and pleuritis	Died 73 hours later.
.p of 3rd, 4th and 5th ribs, ⌐inge external. Pleura free-y opened. Chloroform. 2 sutures	No drainage	No drainage	Syncope on table; traction on tongue revived her	Recovered. Left hospital against advice 12 days after operation.
section of 4th and 5th ribs. Chloroform. 4 catgut su-ures	....	....	....	Died next day; hemorrhage.
ιp of 4th, 5th and 6th ribs, ⌐inge external. 3 sutures	Drainage	Drainage	....	Died 72 hours later.
ιp of 3rd, 4th and 5th ribs, ⌐inge external. Pleura freely ⌐pened. Chloroform. Both wounds sutured with catgut	....	....	....	Died on table.
section of 5th rib. Flap of ith, 7th and 8th ribs, ⌐inge below. No anæsthetic. ⌐ suture	Drainage	Drainage	....	Recovered.
section of 4th and 5th ribs. Both wounds sutured with catgut	Gauze drainage	Drainage	Peritonitis	Died 24 hours later.
ιp of 4th, 5th and 6th car-ilages and part of sternum. Chloroform. 6 sutures	No drainage	Drainage	....	Died 3 days later.
n flap and intercostal in-ision in 4th space, not cut-ing ribs. Ether. 3 silk sutures	Gauze drainage	Drainage	No complications	Recovered.
⌐er. 6 catgut sutures	....	....	....	Died 3 days later.
n flap hinged external. Flap of 3rd and 4th ribs, ⌐inge internal. 6 continuⁱus silk sutures	Gauze drainage	Gauze drainage	Pneumonia. Wound infection	Recovered.
section of 5th rib. Chloroorm. 6 sutures	Drainage	Drainage	Pericarditis and pleuritis	Died 2½ days later.
ιp of 4th and 5th left car-ilages and part of sternum. ⌐inge on the right. Sutured	....	....	....	Died on table; death attributed to pneumothorax.
ιp of 5th, 6th and 7th ribs, ⌐inge external. 4 sutures	No drainage	No drainage	....	Died 48 hours later.

TABLE II—WOUNDS OF TH

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and ro of heart wou
128	SULTAN, C....... 1906	Stab wound in 2d left space, 1 finger's breadth within nipple line	Hæmopericardium, 300~400 c.c.	5 days	Left vent.
129	SULTAN, G....... 1907	Pistol shot wound, 9 mm. in 5th left space, inside nipple line. Male; 38 years	Hæmopericardium, 200 c.c.	30 hours	Left vent ra penetrating , cm.
130	TIKHOFF......... 1908	Stab wound with long, bent shoemaker's needle, outside nipple line. Male; 55 yrs.	Hæmopericardium; marked heart tamponade	1¼ hours	Left vent. p⁰ terior aspe
131	TSCHERNIACHOW-SKI............ 1904	Stab wound in 4th left space, 1 finger's breadth internal to nipple. Male; 24 yrs.	Wound in lung; sutured	Less than 1 hour	Left vent. 5 ⊏ aboveapex. 1' cm.
132	TUZZI.......... 1899	Stab wound in 4th left space near sternum	....	....	Left vent ' wounds, c penetrating
133	VAUGHAN........ 1901	Stab wound dividing 5th costal cartilage. Male, colored; 23 yrs.	2000 c.c. of blood in pleura and pericardium	¾ hour	Left vent ⊐c
134	VELO........... 1902	Stab wound in 6th left space in nipple line. Male; 56 yrs.	Pleura filled with blood. Hæmopericardium, large amount	½ hour	Left vent. non-penetrat⁻ 1.5 cm.
135	VIDAL.......... 1908	Bullet wound (Flobert rifle) in 4th space, 10 cm. from median line. Male; 11 yrs.	....	1¼ hours	Left vent.
136	VINCE.......... 1903	Stab wound in 5th left space	....	12 hours	Left vent.
137	WALCKER........ 1900	20 stab wounds, most of them in 4th left space	Extensive hæmothorax	4 hours	Left vent : wounds, 8 f⁻ wounds in 2]
138	WEINLECHNER... 1904	Stab wounds in 3d and 4th left spaces, within nipple line. Male	....	Very soon	Left vent 2 wounds, 5 ⊏⁻
139	WENDEL......... 1905	Stab wound in 4th left space near sternum. Male; 19 yrs.	....	5 hours	Left vent
140	WENNERSTROM .. 1903	Wound from fragment of glass in 3d left space, near sternum	....	2 hours	Left vent 2 ⊏
141	WILMS.......... 1906	Pistol shot wound, 6 mm.	Wound of lung, perforating, both wounds sutured. Hæmothorax. 1¼ liters	2 hours	Left vent. f⁰⁰ rated
142	DE ZAWADSKI.... 1907	Stab wound	....	....	Left vent. p⁰⁰ ior face
	RIMANN 1909	Gunshot wound perforating 3d rib. Male; 20 yrs.	Hæmopericardium; 100 c.c. Heart tamponade	1¼ hours	Left vent

EFT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postopera-tive complications	Results and remarks
	Pericar-dium	Pleura		
...up of 3rd, 4th and 5th ribs, hinge internal. Silk sutures; first tore out, others placed farther from edge	Drainage	No drainage	....	Recovered.
...up of 4th and 5th left cartilages and part of sternum; hinge on the right. Pleura not opened. Chloroform. 3 silk sutures	....	....	No complications	Recovered.
...section of 4th and 5th ribs. Pleura opened. Anæsthesia (very light). One suture	Edges sut-ured to skin; packed with gauze	....	Slight suppuration in pericardial wound	Recovered. Left hos-pital completely healed 26 days after operation.
...und enlarged; 4th carti-lage and part of sternum resected. Pleura opened. Chloroform. 3 silk mat-tress sutures	Iodoform gauze drain	Gauze tampon	No complications	Recovered. Left hos-pital 6 weeks after operation.
...section of 4th and 5th ribs. No anæsthetic. Sutured	No drain-age	Drainage	Pericarditis, sero-fibrinous empyema	Died 22 days later.
...p of 4th and 5th ribs, 7 cm. wide, hinge upward. Ether. 7 continuous silk sutures	....	....	....	Died on table; hem-orrhage.
...section of 5th and 6th ribs. Pleura freely opened. 3 catgut sutures	Drainage	Drainage	Pleuritis	Died 3 days later. Autopsy: myocar-dium soft and hy-pertrophied.
...ision in 3rd left space, without resecting ribs, under positive pressure. Pleura freely opened. Ether. 2 sutures	No drain-age	No drainage	....	Recovered.
...p of 5th, 6th and 7th ribs. Chloroform. 3 silk sutures	No drain-age	....	....	Died next day.
...ection of 4th rib. 11 silk stitches	Drainage	Drainage	....	Died 1½ days later.
...ection of 5th rib. Chloro-form. Silk sutures	Drainage	Drainage	Pericarditis and pleu-ritis	Died 49 hours later.
...of 4th and 5th cartilages, hinge external. Pleura not opened. Chloroform. 1 cat-gut suture	Drainage	....	Pericarditis	Recovered.
...ection of 4th, 5th and 6th cartilages. 1 catgut and 4 silk sutures	No drain-age	Drainage	3 gauze sponge pads left in pleura; re-moved on 14th day	Recovered.
...rcostal incision in 4th space. Both wounds su-tured. 3 sutures in each	No drain-age	No drainage	No complications	Recovered.
...er. Sutured	Drainage	....	Suppurative pericar-ditis. Wound in-fection	Died 15 days later from secondary hemor-rhage, due to sup-puration in heart wound.
...ction of 4th and 5th car-tilages. Ether. 5 silk sut-es	No drain-age	No drainage	Serous pleuritis; aspir-ation 12 days after operation	Recovered.

TABLE III—WOUN

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and s of heart wou
143	GENTIL.......... 1901	Male; 28 yrs.	....	5 hours	Right auric. cm.
144	GIORDANO....... 1898	Stab wound in 2d left space	....	½ hour	Left auricle. ::
145	GIULANIO........ 1903	Stab wound in 3d left space in nipple line	....	....	Left auricle
146	HARTE.......... 1906	Stab wound in 3d left space	....	....	Left auricle
147	KAPPELER....... 1904	Stab wounds over 3d rib and in 3d left space	....	2½ hours	Left auricle
148	NINNI.......... 1901	Stab wound in 3d left space, near parasternal line	Hæmopericardium, large amount	½ to 1 hr.	Right auricle auricula ra groove. 25:
149	PECK.......... 1908	Stab wound through 3d left cartilage at border of sternum. Female, colored; 23 yrs.	Two superficial stab wounds. Hæmopericardium; marked heart tamponade	¾ hour	Right auric cm.
150	SCHWERIN....... 1903	Sharp pointed body entered 4th left space	....	¾ hour	Right auric
151	THIEMANN....... 1906	Needle 31 mm. in tissues, fixed at upper border of 4th rib. Male; 23 yrs.	Hæmopericardium, .100 c.c.	4 hours	Right auric cm. 1 cm.
152	WILMS 1907	Stab wound. Male; 27 yrs.	Hæmothorax, 3 pints. Hæmopericardium, 50 c.c.	16 hours	Left auricle
	*DUFFY......... 1908	Stab wound dividing 4th cartilage. Male; 23 yrs.	Wound of lung and pleura. Hæmopneumothorax	½ hour	Right auric inch

* Personal communication from Dr. Edward F. Duffy, Yonkers, N. Y. (unpublished).

TABLE IV—MISCELLANEO"

No.	Operator Year	Location	Complicating	Time	Heart perfor
153	BARDENHEUER... 1904 (?)	Gunshot wound	....	....	3 heart wou
154	BORZYMOWSKI ... 1903	Stab wounds over 5th left cartilage. Male; 19 yrs.	Wound of pleura; sutured	....	
155	BRACHINI........ 1901	Stab wound in 4th left space, 3 cm. outside nipple. Male; 15 yrs.	Hæmopericardium, large amount	Soon	Interventric groove. :: Heart wou
156	MAUCLAIRE...... 1903	Stab wound, of left breast, 3 cm. from sternum	....	....	Left coron tery div
157	PAGENSTECHER .. 1901	Stab wound in 4th left space, 1 cm. from sternum. Male; 30 yrs.	....	2½ hours	2 heart wu one ant one post
158	SCHUBERT....... 1904	Bullet wound in 4th left space	....	½ hour	Heart wou
159	ZIEMBISKI 1903	Stab wound	....	....	

THE AURICLES

ative procedure. An- æsthetic. Sutures	Drainage		Course and postopera- tive complications	Result and remarks
	Pericar- dium	Pleura		
....	....	....	....	Recovered.
of 3rd and 4th ribs, ge below. No anæsthetic. lk sutures	No drain- age	Drainage	Left pleuritis. Right pulmonary abscess	Died 18 days after operation.
f 3rd and 4th ribs, hinge rnal. Sutured with silk	Drainage	Drainage	....	Recovered.
tion of 3rd and 4th car- ges. Ether. Catgut ires	No drain- age	Drainage	Pleuritis. Double pneumonia	Died 24 days after operation
of 3rd and 4th ribs, ge internal. Ether. ured	....	Drainage	Pleuritis	Recovered.
tion of 4th and 5th car- ges and part of sternum. anæsthetic. 3 sutures	Drainage	Drainage	Pericarditis and pleu- ritis	Died 3 days later.
f 3rd, 4th and 5th ribs, ge external. Resection art of sternum. Pleura opened. Ether. 4 omicized catgut sutures	No drain- age	No drainage	Pleuritis, mild, non- suppurative	Recovered.
tion of 4th and 5th car- ges. 3 silk sutures	Drainage	Drainage	Pericarditis, pleuritis and pneumonia	Recovered.
tion of 4th and 5th ribs. roform. 4 catgut su- s in auricle, 1 catgut re in ventricle	Drainage	Drainage	Pericarditis, pleuritis and empyema	Recovered. Case also included in table of right ventricle wounds No. 60.
ostal incision in 3rd ce, resection of 1⅞ inch rd rib	Drainage	No drainage	Pericarditis, pleuritis and empyema	Recovered. Out of bed in 3 weeks.
rangular flap of 3d, 4th 5th ribs, hinge external. er. 3 plain catgut sut- s	No drain- age	No drainage	Septic pericarditis; double pleuritis; pneumonia	Died 19 days later of general sepsis.

RT WOUNDS

entrance and exit nds sutured	....	....	Pericarditis and pleu- ritis	Died 3 days later.
All three wounds ed with silk sutures	....	....	Severe sepsis; sup- purative pericardi- tis; discharge of silk sutures. Em- pyema—thoracot- omy, 3rd rib, 6 months later	Recovered.
f 2nd, 3rd, 4th and 5th hinge internal. Pleura ned. No anæsthetic. 5 sutures		Drainage	Pericarditis and pleu- ritis, purulent	Died 42 hours later. due to infection of pleura and pericar- dium.
f 3rd and 4th ribs. 3 res	Drainage	Drainage	....	Died 24 hours later.
f 4th and 5th cartilages, e internal. Ether. Both s of divided artery se- d with sutures	....	....	Pericarditis and pleu- ritis	Died 4 days later.
tion of 4th rib. Chloro- n. Both wounds sutured 1 catgut	....	....	....	Recovered. Operator thought bullet went through interven- tricular septum without opening either ventricle.
d	....	....	....	Died.

teriorly by separate rib resection as in empyema, and not through the operative wound. If the lung is collapsed from the pneumothorax, aspiration drainage could be employed.

Careful suture of the soft parts should be made to prevent the sucking in of air through accidental or intentional operative wounds of the pleura. Any attempt to draw conclusions as to the effect of drainage as regards infection in reported cases seems rather hopeless, as the percentage of infected cases in the drained and the non-drained cases does not differ greatly. The fact that so large a percentage of the fatal cases (more than 60 per cent.) have escaped the first danger of hemorrhage and shock, and have succumbed later from other causes, generally of infective origin, leads to the hope that the future will show a substantial diminution in the mortality of cases operated upon.

Already one recent heart wound has been sutured under positive pressure (Vidal, Case 136).

Resection of a portion of one or more ribs without flap formation has been frequently done with satisfactory results.

The quadrangular flap with hinge external and *the long intercostal incision* with division of one or more cartilages at their sternal attachments, seem to me the best methods. For wounds far to the right, removal of a part of the sternum could be added to either method.

To gain sufficient experience by operations upon the human subject is out of the question. It is necessary, therefore, for every surgeon to whom such an opportunity may come, to be prepared to meet it at a moment's notice. A well formed plan of action, rehearsal of the technic if possible on the cadaver, together with the knowledge to be gained by the study of original case reports and experimental work, will be of inestimable value to the surgeon who may be called upon to meet this important emergency.

Note.—No attempt has been made to analyze exhaustively all the facts contained in the Tables, page 108 to 129. References are given as completely as possible to original case reports, which are replete with interesting and instructive de-

tails quite worthy of perusal. Cases incorrectly included or reduplicated in previously published series have been excluded as far as possible; *e.g.,* the case of Brenner, which has been published as three separate cases credited to Brenner and Zulehener. No effort has been made to include in the Bibliography all important contributions to the subject of heart surgery.

BIBLIOGRAPHY.

[1] Alvez de Lima: Gazett. Clin.; S. Paula, 1905, iii, 386.

[2] Bardenheuer: Allegemein. Aertzl. Verein zu Koln, 1904, July 4, Munch. med. Woch., 1904, No. 34, 1534.

[3] Barth (reported by Wolff): Deutsche Zeitsch. f. Chir.; Leipzig, 1903, lxix, 67.

[4] Baudet: Bull. et Mém. Soc. de Chir. de Paris, 1907, n. s., xxxiii, 10.

[5] Bayha: Med. Corr. d. Wurtem. arztl. Land., 1908, lxxviii, 477.

[6] Blake: ANNALS OF SURGERY, Philadelphia, 1908, xlviii, 138.

[7] Borchardt: Sammlung. klin. Vortrage, Leipzig, 1906, N. f. Chir. 102–127, p. 297. (Nos. 411, 412; Chir. 113, 114.)

[8] Borzymowski: Medycyna, Warsaw, 1904, xxxii, 506, 622.

[9] Bougle: Bull. de la Soc. Anat. de Paris, 1901, lxxvi, 122.

[10] Brachini (rep. by A. Liscia): Clinica Chirurgica, Milano, 1901, Aug. 31.

[11] Brenner (rep. by Zulehner): Wiener klin. Woch., 1901, xiv, 263.

[12] Brezard et Morel: Bull. de la Soc. Anat. de Paris, 1905, lxxx, 835.

[13] Bufnoir: Bull. et Mém. Soc. Anat. de Paris, 1899, lxxiv, 65.

[14] Camus: Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 80 and 676.

[15] Cappelen: Norsk. Mag. f. Laegev., Kristiana, 1896, 4, R., xi, 285.

[16] Capello-Cimorini: Bull. d. Soc. Lancisiana d'osp. di Roma, 1904, xxiv, 239.

[17] Carmelo: Clinica Chirurg., Milano, 1905, 103.

[18] Carnabel: Bull. et Mém. Soc. de Chir. de Bucarest, 1900–1901, iii, 144.

[19] Chastenet de Gery: Gaz. Méd. de Nantes, 1908, xxvi, 651.

[20] Del Vecchio: Riforma Med., Napoli, 1895, xi–ii, 38.

[21] Dolcetti: Centralblatt. f. Chir., Leipzig, 1906, xxxiii, 566.

[22] Duval: Bull. et Mém. Soc. de Chir. de Paris, 1907, xxxiii, 15.

[23] Elsberg: Jour. Exper. Med., N. Y., 1899, lv, 479.

[24] Farina: Trans. xi, Ital. Cong. Surg., 1896, Rome.

[25] Fischer, E.: Ungar. Med. Press, Budapest, 1907, xii, 19.

[26] Fittig, O.: Beitrag. zur klin. Chir., Tubing., 1907, lx, 567.

[27] Fontan: Bull. et Mém. Soc. de Chir. de Paris, 1900, xxvi, 492; ibid., xxvii, 1099, 1901.

[28] de Fourmestraux: Bull. et Mém. Soc. de Chir. de Paris, 1905, xxxi, 818; Bull. Soc. Anat. de Paris, 1906, lxxxi, 316.

[29] Fummi (in Ramoni): Bull. d. Soc. Lancis, d. osp. di Roma, 1899, xix.

[20] Gaudemet: Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 142.

[21] Gentil: Rev. portug. de med. e Cirurg., Lisbon, 1901, x, 353; Med. contemp., Lisbon, 1904, 2. s. xi, 109, 111.

[22] Gentil: Congr. internat. de méd., Lisbon, 1906, sec. ix, 446.

[23] Gerzen: Medizinsk. Obosrenije, Mosk., 1904.

[24] Gibbon: Phila. Med. Jour., 1902, Nov. 1; Trans. Coll. Phys., Phila., 1905, s. 3, xxvii, 213.

[25] Giudice: Pammatone, Genoa, 1905, ix, 74.

[26] Giordano: La Riforma Medic., 1898, xiv, iii, 674; La Chirurgia del pericardio e del Cuore, 8, Napoli, 1900; Gazz. d. osp., Milan, 1903, xxiv, 49.

[27] Giulanio: Gazz. d. osp., Milan, 1905, xxvi, 322.

[28] Goebell: Verhand. der Deutsch. Gesellsch. f. Chir., 1906, xxxv, ii, 70.

[29] Grassman: Munch. med. Woch., 1908, lv, 2379.

[40] Grekow and Zeidler: Centralblatt. f. Chir., 1905, 588; Russ. Archiv. f. Chir., 1904, xx, 974 (St. Peterb.).

[41] Guenot: Bull. et Mém. Soc. de Chir. de Paris, 1905, xxxi, 392; Bull. Méd., Paris, 1904, xviii, 585.

[42] Guinard: Bull. et Mém. Soc. de Chir. de Paris, 1904, xxx, 705.

[42(a)] Haecker: Archiv. f. klin. Chir., Berlin, 1907, lxxxiv, 1035.

[43] Harte: ANNALS OF SURGERY, Phila., 1907, xlv, 672.

[44] Henriksen: Norsk. Mag. f. Laegev., Kristiana, 1902, lxiii, 1023.

[45] Hesse: Sitzung. d. phys. med. Gesellsch zu Wurz., 1906, p. 2–5; ibid., 92, 1905.

[46] Hill: Med. Record, N. Y., 1902, lxii, 846.

[47] Horodynski: Medycyna, Warsaw, 1899, xxvii, Nos. 21 and 22, 460, 528.

[48] Isnardi and Colombino: Giorn. d. R. Acad. di Torino, 1903, Nos. 4 and 5.

[49] Janari: Policlinico, Roma, ser. Chir., 1903, No. 5.

[50] Kappeler: Deutsch. Zeitsch. f. Chir., 1904, lxxii, 603.

[51] Kosinski: Kronika Lekarska, 1899; Jahresbr. f. Chir., 1899.

[51(a)] Kronecker and Schmey: Sitzungsb. der Akad. der Wissench. zu Berlin, 1884.

[52] Lastaria: Riforma Med., Rome, 1901, xvii, i, 808.

[53] Launay: Bull. acad. de med. de Paris, 1902, xlviii, 185.

[54] Lemaitre: Bull. Soc. Anat. de Paris, 1903, lxxviii, 575; Thèse de Paris, 1905.

[55] Lenormant: Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 681; Gazette des Hopitaux, 1906, lxxix, 1239.

[56] Liscia: Clinica Chir., Milan, 1901, ix, 674.

[57] Longo: Gazz. d. osp., Milan, 1899, xx, 229.

[58] Malizewski: Medycyna, Warsaw, 1899, xxvii, Nos. 21 and 22, 469, 528.

[59] Manteuffel: Centralblatt f. Chir., 1905, xxxii, 1096.

[60] Marion: La Presse Méd., 1899, vii, 148.

[61] Maselli: Policlinico, Rome, 1899-1900, vi, 1345; Bull. d. Soc. Lancis, d. osp. di Roma, 1900, xx, 164.
[62] Mauclaire: Russk. Archiv. Chir., 1903, 1131.
[63] Mignon et Sieur: Bull. et Mém. Soc. de Chir. de Paris, 1901, xxvii, 422.
[64] Milesi: Policlinico, Roma, 1904, xi, 1274.
[65] Morestin: Archiv. gen. de Med., 1903, ii, 2380.
[66] Musumeci: Clinica Chir., Milan, 1905, xiii, 641; Clinica Chir., Milan, 1908, xvi, 292.

[67] Nanu: xiii Congr. Internat. de Med., Paris, 1900, x (chir.), 602.
[68] Neumann: Deutsch. med. Woch., Leipzig and Berlin, 1898, xxiv, Ver. Beil., 90; Berlin, klin. Woch., 1905, xlii, 643.
[69] Nicolai (in Ramoni): Gazz. Med. di Roma, 1899, xxv, i, 29.
[70] Nietert: Interstate Med. Jour., 1901, 563; Interstate Med. Jour., 1902, 5.
[71] Nimier: Archiv. de Méd. et de Pharm., Milit., 1906, xlvii, 209.
[72] Ninni: Atti. d. R. Acad. Med. chir. di Napoli, 1898, lii, 320; ibid, lv, No. 3, 1901.
[73] Noll: Verhandl. Deutsch. Gesellsch. f. Chir., 1903, xxxii, 168.

[74] Pagenstecher: Deutsch. med. Woch., Leipzig and Berlin, 1899, xxv, 523; ibid., xxvii, 56, 1901.
[75] Parozzani: Bull. d. R. acad. Med. di Roma, 1896, 7, 243.
[76] Peck: ANNALS OF SURGERY, Phila., 1909, xlix, 135.
[77] Pecori: Policlinico, Rome, 1902-3, ix-x, 501.
[78] Picone: Clinica Chirurg., Milano, 1904, xii, 1129.
[79] Pomara: Gazz. d. Osp., Milan, 1902, No. 129.

[80] Quenu: Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 316.

[81] Ramoni: Gazz. Med. di Roma, 1899, xxv, i, 29.
[82] Rehn: Verhandl. Deutsch. Gesellsch. f. Chir., 1897, xxvi; Archiv. f. klin. Chir., 1907, lxxxi, 723.
[83] Renon: Tribune Med., Paris, 1904, n. s., ii, 39.
[84] Ribas y Ribas: Rev. de med. y cirurg., Barcelona, 1906, xx, i.
[85] Riche: Bull. Soc. Anat. de Paris, 1904, lxxix, 370; Bull. et Mém. Soc. de Chir. de Paris, 1905, xxxi, 172.
[85] (a) Munch. med. Woch., 1909, April 13.
[86] Rosa: Clin. Chir., Milan, 1899, vii, 836; Policlin., Rome, 1900-1901, vii, sez. prat., 449.
[87] Rothfuchs: Deutsch. zeit. f. Chir., 1905, lxxvii, 603.

[88] Savariaud: Congres français de Chirurgie, 1902; Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 319.
[89] Schakhovskoi: Russk. Khirurg. Obozr., Mosk., 1903, i, 589.
[90] Schubert: Deutsch. Zeitschr. f. Chir., 1904, lxxv, 71.
[91] Schwerin: Verhandl. d. Deutsch. Gesellsch. f. Chir., Ber., 1903, xxxii, i, 166-168.
[92] Senni: Clinica. Chir., Milan, 1903, xi, 1067.
[93] Smith: Southern Cal. Pract., 1904, xix, 337.

[94] Soave: La Riforma Med., 1908, xxiv, 121.
[95] Somerville: Lancet, Lond., 1904, 1278.
[96] Spangaro: Clinica Chir., Milan., 1906, xiv, 227.
[97] Stewart, F. T.: Am. Jour. Med. Soc., Phila., 1904, cxxviii, 432.
[98] Stewart, G. D.: Personal Communication.
[99] Steyner: Panietnik. Lekarsk., Warsaw, 1903.
[100] Stude: Deutsch. Militär. ärztl. Zeitschr., 1904, xxxiii, 20.
[101] Sultan, C.: Verhandl. der Deutsch. Gesellsch. f. Chir., 1906, xxv, 125.
[102] Sultan, G.: Deutsch. med. Woch., 1908, xxxiv, 277.

[103] Thiemann: Archiv. f. klin. Chir., 1907, lxxxiii, 565.
[104] Tikhoff: Khirurgia, Mosk., 1908, xxiii, 485.
[105] Travers: Lancet, Lond., 1906, ii, 706.
[106] Tscherniachowski: Deutsch. Zeitsch. f. Chir., 1906, lxxxiii, 288.
[107] Tuzzi (in Ramoni): Gazz. Med. di Roma, xxv, i, 29.

[108] Vaughan: Med. News, 1901, Dec. 7, p. 881. Jour. Amer. Med. Assoc., 1909, lii, 438.
[109] Velo (Terrier et Reymond): Rapport au Congres français de Chirurgie, 1902.
[110] Vidal: Vingt-et-unième Congr. de Chir. de Paris, 1908, 637.
[111] Vince: Jour. de Chir. et Ann. Soc. belge de Chir., Brux., 1903-4, iii, 198-202.
[112] Vogel: Centralblatt f. Chir., 1904, xxxi, 683.

[113] Walcker: Berlin. klin. Woch., 1900, xxxvii, 1193; Deutsch. zeitschr. f. Chir., Leipzig, 1900, lviii, 105.
[114] Watten: Deutsch. med. Woch., 1901, xxvii, 627; Gazz. lek., Warsaw, 1900, v. s., xx, 963.
[115] Watts (quoted by Vaughan): Jour. A. M. A., 1909, lii, 438.
[116] Weinlechner: Wiener Klinik, 1904, 146.
[117] Weiss: Rev. méd. d. l'est, Nancy, 1905, xxxvii, 504.
[118] Wendel: Verhandl. Deutsch. Gesellsch. f. Chir., 1906, xxxv, 215.
[119] Wennerstrom: Upsala Lak. Fordhand., viii, 1903; Centralblatt f. Chir., 1903, 1055.
[120] Wilms: Centralblatt f. Chir., Leipzig, 1906, xxxiii, 817.
[121] Wilms (by Meerwein): Munch. med. Woch., 1907, liv, 1784.

[122] de Zawadski: Vingtième Congr. de Chir. de Paris, 1907, 234.
[123] Ziembiski: Przeglad, Lekarsk., 1903, 600.

THE OPERATIVE TREATMENT OF TUBERCULOSIS OF THE LUNGS WITH TOTAL THORACO-PLASTIC PLEUROPNEUMOLYSIS.*

BY P. L. FRIEDRICH.

OF MARBURG, GERMANY,

Professor of Surgery in the University of Marburg.

IF I presume to discuss before this illustrious assembly the subject of the operation of lung tuberculosis, it is because the matter is comparatively new on the one hand, while on the other it has provided me with a measure of personal experience such as to justify one in claiming the interest of wider professional circles for this pending problem. Having availed myself of various opportunities in Germany, for this purpose, I appreciate it as an especial distinction and privilege now to submit our experience.

Through an especially favorable coincidence, I had been engaged for several years upon experimental studies concerning the compensation of space in the thoracic cavity after the removal of an entire lung, while my colleague of the Internal Department, Professor Brauer, in his detailed studies of the treatment of tuberculosis with artificial pneumothorax, felt the necessity of more radical surgical measures.

In these experiments, I showed not only that the ablation of one lung is readily tolerated by animals immediately after the interference, but I ascertained also their excellent condition later, in regard to increase in body weight and further growth. The most important feature of these experiments was, that when the animals were killed, a long time after (one to one and a half years), the cavity caused by the removal of the lung was found to have become perfectly compensated—the heart taking the place of the pulmonary defect, in right-sided

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as well as left-sided amputation of the lung; and also that the remaining lung shows not only an increase in volume, but in a small portion even fills the defect left by the heart on the amputated side (Fig. 1). Moreover, the diaphragm at the site of the operation helped to diminish the defect, by rising higher up. The ribs on the operated side undergo atrophy, without a rib having been injured at the operation, to such an extent that the chest-wall itself *helps to diminish the defect by becoming flattened and shrunken.* I present a series of corresponding photographs, so that those among you who are interested in this matter, may inspect the specimen photographs directly.

In addition to this, I was enabled to observe, in my former clinic in Greifswald, in a patient with extensive tuberculosis of the lungs and ribs, a favorable influence upon the pulmonary tuberculosis which astonished myself and my assistants, after ablation of almost the entire bony wall of the thorax on the diseased side. Thereupon, when my colleague in internal medicine referred to me cases in which pneumothorax therapy proved a failure on account of mutual adhesions of the pleural layers, we determined, after reviewing the various possibilities of surgical intervention, to assist the tendency of a still youthful lung toward shrinkage, with tuberculous cavernous destructive processes, in such a way that I de-ossified, as it were, the thoracic wall by ablating the ribs from the second to the tenth, from the spinal column as far as the costal cartilage at the sternum, the lung thus being made to collapse towards the hilus.

The course of our procedures was described last year, in an article published in *Surgery, Gynæcology and Obstetrics.* At the present day I am in a position to look back upon a measure of experience which permits me to outline more sharply the indications for this interference; to state how its dangers are most efficiently managed; and, finally, to specify the total results of the operation.

In adopting this course we stood by no means alone, but

(as I have always pointed out in grateful acknowledgment of their scientific and practical preliminary labors) Quincke, Spengler, Turban, and Landerer had previously suggested that in all cases of unilateral phthisis showing a tendency to shrinkage of the lung, or over cavernous lung segments in general, the natural mechanism of the shrinking process, that caused the lung which was maintained at a certain rigid tension, to collapse through the removal of the ribs should be further reckoned with.

The same idea underlies the attempts of Forlanini, Murphy, Lemcke and Schell, Brauer, and A. Schmidt, to induce a restriction in the volume of the lung through the production of artificial pneumothorax.

The ablation of the bony chest wall must be carried out rapidly and accurately,—and this act can be completed within thirty to forty minutes, under employment of very small amounts of anæsthetic (0.015 morphine, local anæsthetic injections, and 6–10 gr. chloroform). The atmospheric pressure on the elastic chest wall now merely consisting of soft parts, then leads immediately to a very complete collapse-effect upon the lung, similar to pneumothorax. Only in case the lung contains calcified or dense fibrous masses in its interior, or when a former pleuromediastinitis has raised a sort of solid resistant rampart in a mesial direction, is the immediate retraction of the lung not so evident. Also the reaction upon the heart, in regard to displacement as well as change of the pulmonary circulation, is not so marked in these cases. At any rate, however, the intervention leads to (1) collapse of cavernous lung tissue; (2) extensive exclusion of the lung on the operated side from the respiratory function; (3) retardation of the pulmonary circulation in this lung; (4) through the arrest of breathing in this lung, an essential diminution of the lymphatic circulation and absorption.

The natural results of the interference are, in the first place. a considerable taxation of the opposite lung for the respiratory function. Very promptly a compensatory increase of

volume is developed in this lung,—as I am enabled to demon·
state to you in the series of pictures which I present (Fig. 6).

Whether this immediate increase in volume of the other
lung develops in the further course into a compensatory
emphysema, or whether the increased functional activity is
followed by genuine hypertrophy of lung tissue—as in other
paired organs of the body—cannot yet be positively deter-
mined, as none of the operated patients have died at the end
of a long time, so that the question could be settled on the
autopsy table. Here again our current experimental work
enters into consideration. At any rate, the problem is of great
theoretical and practical interest, and it requires very careful
investigation.

It cannot as yet be considered as definitely settled, and
there are sure to be certain differences in the course taken
by individual cases, in how far tuberculous foci of the side not
operated upon will undergo a more rapid evolution, or be
affected in a favorable way. In several cases, slight aggrava-
tions were noted immediately after the operation, but we never
had a regrettable acceleration of the general course, or a death;
on the contrary, we became convinced that in the majority of
the cases the foci on the opposite side are favorably influenced.
An unconditional preliminary requirement for admission to the
operation is to select *only such cases of unilateral phthisis in
which the other side is not simultaneously affected with active
progressive foci, passive* processes alone being present. In the
further course, it may prove harmful, as was noted in two of
our cases, that the de-ossified chest wall remains permanently
boneless. In the first of our cases, we considered it as an
object of the operation to ablate the retrocostal periosteum as
completely as possible, and to make the pleura yield. Through
the above experience, we have been led to *leave the retrocostal
periosteum behind,* at present. It is then in our power to
render the shrinkage of the lung very thorough within a few
months, under simultaneous light pressure upon the operated
side. After this period of shrinkage, the re-establishment of

periosteal ossification is desirable, in order to counteract the bulging out of a still inflatable portion of lung in the act of coughing. A case among our latest observations, in which this regeneration has occurred in all of the ribs, belongs to the most favorable results of our treatment.

I have recently gone a step further, in the mobilizing and loosening of the lung tissue, by detaching separately in the course of the operation the pulmonary *apex,* together with the overlying costal pleura from the entire surroundings, or by removing the first rib also, thereby rendering the apex of the lung more shrinkable. As showing the shrinkage of the lung in our recent patients taking place in the course of several months, I will mention particularly two cases. In one we had to deal with a rapidly progressive and at the same time infiltrating tuberculosis; and in the other a badly weakened, desperately ill patient, with extremely severe, highly febrile right-sided phthisis. I adhered to my mode of incision in all the total pleuropneumolyses, limiting myself only in the case of female patients to a predominantly posterior incision with full preservation of the breast. In my last cases, I detached the apex of the lung by itself and endeavored to induce its shrinkage. The radiographs show how markedly the first rib gradually descends in our operated cases, becoming displaced mesially, and together with the soft parts of the shoulder, the clavicle and the scapula, furthers the restriction in volume of the pulmonary apex. In my most radical procedure of de-ossification of the chest-wall, the first rib had always been preserved, in consideration of the fact that its removal adds considerably to the length of the operation, increases the technical difficulties, and thus heightens the risk run by the patient. Blunt subcostal detachment, on the other hand, may be carried out quickly, easily and without damage (apicolysis). The total structure of the lung apex is thus rendered still more susceptible to shrinkage. My original intention in these two cases (October and December, 1908), was to remove the first rib also; but the difficulty of

enucleating the rib induced me to adopt the conservative pro-
cedure of *subcostal apicolysis*. In the absence of old perios-
teal inflammations of the ribs, as a sequel to *apicopleuritis*, as
existant in the above two cases, the ablation of the first rib is
not, however, attended with special difficulties. The first skin-
muscle-flap incision should be *carried up higher in the posterior
circumference*, and the plastic flap be pushed gently away until
beyond the first rib; the subclavian artery and vein are sus-
pended in the flap; the anterior and posterior scaleni are trans-
versely divided with the knife at their costal insertion, or de-
tached by blunt dissection. The insertion of the scaleni may
be very firm; they do not necessarily follow the periosteum as
it is levered off. The first rib can now be raised with my
rounded elevator, and removed like any other rib. It goes
without saying, that the ablation of the first rib induces the
most thorough shrinkage of the pulmonary apex. In a case
which was recently operated upon, I removed the first rib also.

Several cases have caused me to try circumscribed costal
ablations when the lesion concerned exclusively the lower lobe
or the upper lobe, and was apparently circumscribed. In a
general way, however, I wish to summarize the result of these
operations, to the effect that it will always prove advisable to
*extend the scope of the operation considerably beyond what
seems to be required by the extent of the lesion.* The reason
for this is, that the collapse of the lung takes place to a rela-
tively slight extent only when the number of the ablated ribs is
not considerable, and the individual ribs have not been com-
pletely removed. The continuity of the costal pleura prevents
the lung from sinking in as far as desired.

As has been pointed out in my last publications, the cases
should be *strictly selected*, and *only* those patients operated
upon who have *unilateral* cavernous lesions, with at most
passive foci on the opposite side. They must be free from
evident recent tuberculous processes in other regions of the
body, more particularly the bowel.

STATISTIC TABLE.—A. UNILATERAL LUNG PHTHISIS.   TOTAL PLEURO-
PNEUMOLYSIS.   (II–X RIB.)

Case No.	Sex	Age	Position
1	Man	28	Left side *
2	Man	18	Left side *
3	Woman	32	Right side *
4	Man	31	Right side *
6	Woman	30	Left side ‡
8	Man	16	Right side *
10	Man	21	Left side (also apicolysis) †
11	Man	23	Right side (also apicolysis) *

B. MULTIPLE TUBERCULOSIS OF THE BODY.   I. TOTAL THORACOPLASTIC
PLEUROPNEUMOLYSIS.

Case No.	Sex	Age	Position
7	Man	17	Left side (also progredient intestinal tuberculosis and nephritis). Death, 5th day.
14	Man	34	Right side (also extensive suppurative costal tuberculosis) ‡
13	Man	19	Left side (also laryngotuberculosis, removal of the 1st rib). Death, 3d day.

II. PARTIAL PLEUROPNEUMOLYSIS; PARTIAL REMOVAL OF THE RIBS.

Case No.	Sex	Age	Position
5	Man	35	Left side, also right recent cavernous phthisis and larynx phthisis. Death, 4th day.
9	Man	47	Right side, also progredient suppurative costal tuberculosis. Death, 2nd day.
12	Man	40	Right side, and circumscribed cerebral tubercle.†

Certain recent cases have encouraged me to extend the procedure also to conditions of *slowly infiltrating non-cavernous phthisis,* since Case 8 showed, that the arrest of respiration is in itself capable of creating relatively favorable conditions for the cure of this type of phthisis also.   These statements are made cautiously and guardedly, however.

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* = Good, or best, recovery.
† = No better than before the operation.
‡ = State not so good as before the operation.

The direct mechanical effect upon the heart, through the collapse of the diseased lung, may constitute a serious feature of the operation, as I have shown in former publications. It does not manifest itself, however, in the presence of conditions such as those pointed out above, when the lung which is to be constricted is already very rich in connective tissue, and when the formation of pleural and mediastinal adhesions guarantees a certain stability of the topical relations in the interior of the thorax. I have furthermore succeeded in guarding against the danger of acute dislocation of the heart, by a simple device, namely, raising the arm of the affected side above the horizontal plane and still keeping the lung of the operated side somewhat in the balance, as it were, through the traction of the scapula and muscles, so that the effect upon the heart is allowed to manifest itself only gradually. The sum total of our experiences is that we have not lost a single patient through this cardiac disturbance.

In so far as the circulatory stasis in the blood and lymph currents of the lung on the operated side may mean a direct advantage for the local cure of the tuberculosis and for the restriction of its further spread, this must be left an open question for the time being.

In four of our cases, a slight scoliosis of the vertebral column has developed, with the convexity towards the side of the operation (Fig. 3). The absence of the ribs as points of leverage for the shrinking, accounts for this form of the scoliosis. It is not marked enough in any case, not to be readily accepted by the patients in view of their otherwise improved condition.

The function of the serratus, elevation and other motions of the arm are very completely re-established after the operation, sometimes after having been impaired during several months. Only recently I had the opportunity of re-examining three male patients who had been operated upon on the right side, and had not sustained the slightest loss of strength in the right arm and right shoulder. I exhibit the pictures of one of these patients, with extensive right-sided cavernous phthisis,

FIG. 2.
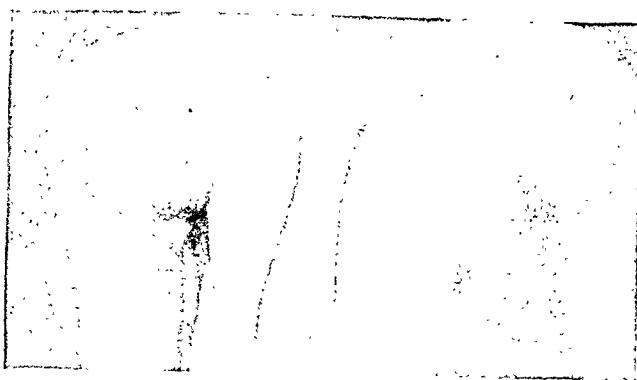
FIG. 3.
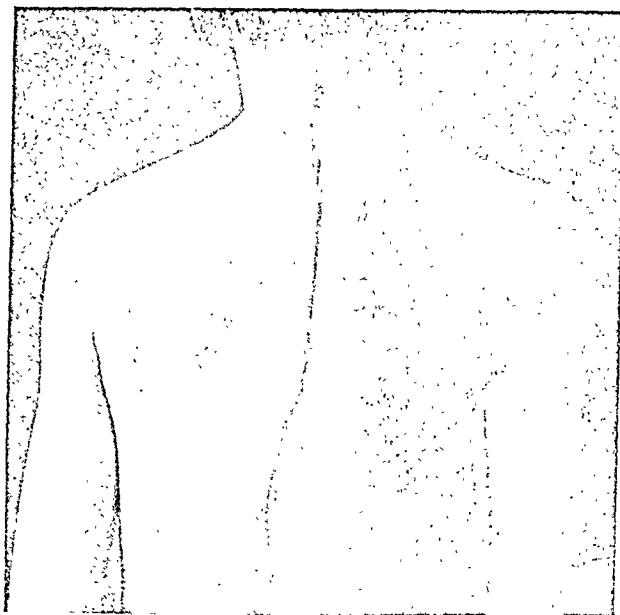
FIG. 4.
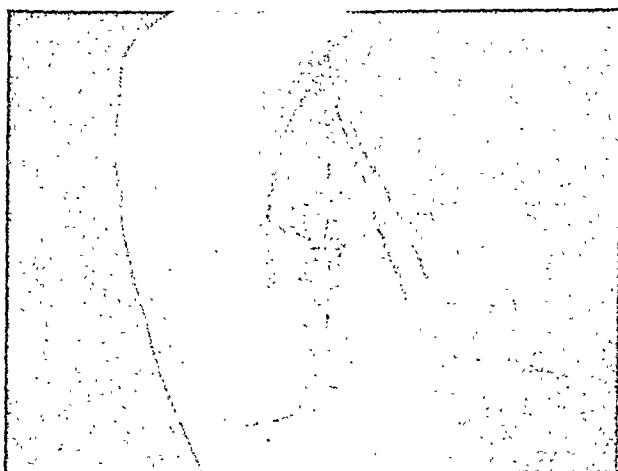
Phthisis, right lung. Total pleuropneumolysis. Best recovery
Dislocation of the sternum and vertebral column.

FIG. 5.
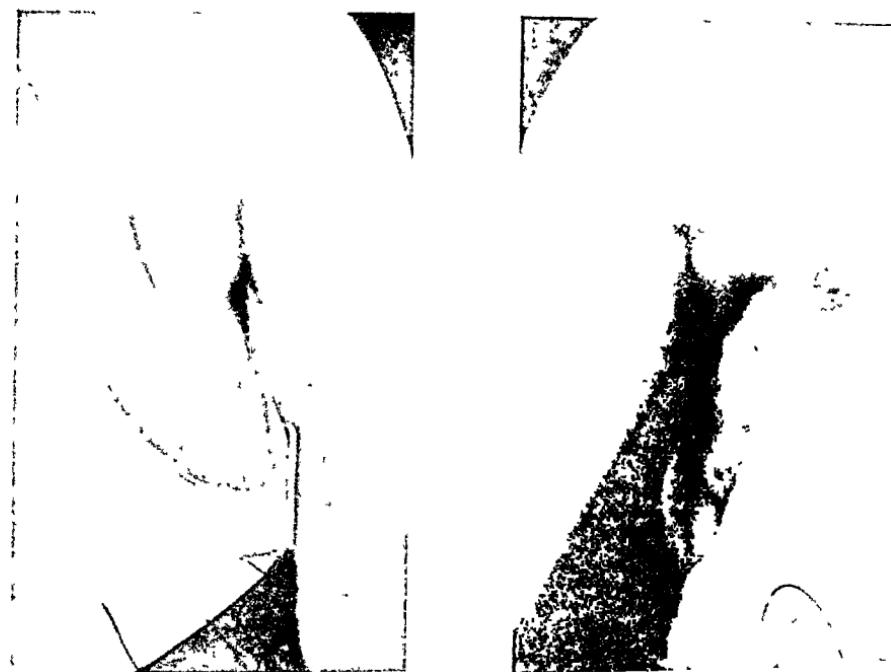
CASE IV.—Extensive cavernous right-sided phthisis   Total pleuropneumolysis.   Two and a half months, and one year after.

FIG. 6.

CASE VI.—Diagram showing compensatory increase of volume developed in opposite lung.

photographed two and a half months and one year after the operation (Fig. 5).

The essential results of this treatment have already been published in German periodicals, and I am now in the fortunate position to state that we were again and again enabled to note a confirmation of our first experiences.   The immediate results in the course of the disease are usually particularly impressive; *defervescence* follows rapidly, as a rule in patients with a high fever.   The subsidence of the fever must be a result of the changed conditions of absorption, and accordingly permits a conclusion as to the favorable influence upon the latter, that becoming an *objective graduator* for the immediate effect of the operation.

In every case the amount of sputum is reduced enormously (from 200 to 10 cm. and less) within some days, at most weeks, after the operation, and the irritative cough diminishes. This would seem to justify the conclusion that it is the collapse of the cavities, after the relaxation of the lung tissue, and the cleansing of the cavity wall, which induces this result. This is the most impressive feature for the patient to begin with.   Our past experience further shows, however, that not only the cavernous tissue is favorably influenced by *putting the lung at rest,* but so also to a considerable extent, is the as yet non-disintegrated, infiltrated portions.   This is rendered intelligible in view of the encapsulation and cure of tuberculous foci, frequently observed elsewhere after the fixation of organs affected with tuberculosis.   The potential conditions for curability are certainly more favorable in the lungs than in most other organs with the tuberculous affections of which we are concerned.   Our verdict in this respect must necessarily be guarded, in view of the lack of post-mortem evidence.   Should this observation be further confirmed, it would materially extend the indications for our intervention.

In all our cases, an increase of the body weight and improved subjective condition are noted in the further course. It remains of the greatest importance to see to it that in the selection of the cases for the operation, the patient has not yet

passed his fortieth year, that the general nutrition either is fairly good or is rendered as favorable as may be prior to the performance of the operation, by means of climatic treatment, rest in bed, and dietetic measures. It is also necessary to ascertain that aside from the diseased lung of one side, there are *no recent* tuberculous manifestations in other organs. I should certainly be extremely cautious in the admission of such cases, and have only had reason for regret whenever I have allowed myself to be persuaded to operate on the request of patients who had been dazzled by our results in other cases. Three such patients, with multiple tuberculosis (also of the larynx, bones or bowel), died in immediate connection with the operation.

Concerning the extent of the affection on the diseased side, however, we have no restriction to offer at present, simply repeating that the more complete a restriction in volume can be obtained, the more complete will be its beneficial effect. Our cases without exception concerned very far advanced consumptives, in all of whom the prognosis of persistent aggravation had been rendered by highly competent physicians. Hence, he who interferes with a grave condition such as this by means of such a radical operation, will keep in mind that the measure of success cannot be guaranteed, and is necessarily relative only. But even if surgical interference improves the situation in so far only as to lengthen the lives of a certain percentage of otherwise doomed consumptives, giving them a sensation of returning health, and introducing more or less positive objective amelioration of the general condition and the local lesion, this means a step in advance which physicians and patients will hardly fail to appreciate.

RESECTION OF RIBS, COMBINED WITH EXTERNAL PRESSURE, IN THE TREATMENT OF TUBERCULOSIS OF THE APEX OF THE LUNG.*

BY LEONARD FREEMAN, M.D.,

OF DENVER, COLO.,

Professor of Surgery in Denver and Gross Colleges of Medicine.

ALTHOUGH so much has been done towards the successful management of pulmonary tuberculosis, through climate and hygiene, the possibilities of surgery should not be lost sight of, especially in cases which resist ordinary methods of treatment. Enthusiasm in this direction, however, should be tempered with reason and caution, bearing in mind that many obstinate cases recover spontaneously. No operation should therefore be considered that does not offer at least a fair likelihood of substantial improvement, without too much danger, and without too great a prospect of leaving the patient worse than before, although it must be admitted that desperate measures may occasionally be advisable in desperate cases. From this point of view, such operations as pneumonectomy, pneumonotomy, and Friedrich's " costoplastic pneumolysis " should be approached with caution.

One of the most potent factors in the cure of pulmonary tuberculosis, with or without the presence of cavities, is the gradual formation and contraction of fibrous tissue, which seems to be promoted by collapse of the lung and freedom from motion. Hence any procedure favoring pulmonary retraction, as a whole or in part, should be of service. A spontaneous tendency in this direction exists in the subclavicular flatness, intercostal hollowing, and drooping of the shoulders, so often observed in consumptives; and it is suggestive that athletic individuals with well developed and powerful thoraces often exhibit the most rapid and hopeless forms of phthisis.

* Read before the American Surgical Association, June 3, 1909.

Pulmonary collapse may be obtained, to a greater or less extent, in several ways: (1) By the production of an artificial pneumothorax (Murphy, Forlanini). (2) By extrapleural resection of nearly all of the ribs below the first, from their cartilages to the spine, and including their periosteum (Friedrich). (3) By the removal of portions of some of the ribs, with their periosteum, along the axillary line (Quincke, Spengler, Turban, Landerer, Garré, etc.). (4) By the resection of portions of several ribs and their periosteum directly over the diseased part of the lung, usually a cavity near the apex. (5) By a similar operation, without the removal of the periosteum, followed by external pressure by means of a truss, this being the procedure to which I desire to call attention in this paper.

The Murphy-Forlanini method is quite free from danger and is of undoubted value when the lung is free; but when adhesions are present its feasibility and usefulness are correspondingly lessened. In disease of the apex, especially if advanced and with a tendency to the formation of cavities, the procedure is restricted in its usefulness, because of adhesions which prevent collapse and cause continuous movements in unison with those of the thoracic wall. This does not necessarily mean, however, that nothing is gained, because tuberculosis of other portions of the lung may be benefited; but it does mean that the chest-wall directly over the diseased apex must be mobilized if the best results are to be obtained.

Friedrich's costoplastic pneumolysis is an extensive operation and by no means free from danger, especially in the advanced cases where it is most strongly indicated, requiring, as it does, the complete removal of nearly all the ribs, together with their periosteum. The technic is difficult, because the delicate pleura must not be torn; and the work must be rapidly done owing to the weakened condition and defective circulation and respiration of the patient. Manifestly the method is only justifiable in extensive lesions, where adhesions exclude the production of an artificial pneumothorax, and where all ordinary treatment has failed.

The removal of portions of ribs and their periosteum along the axillary line varies in danger and difficulty according to the extent of the operation. Its effectiveness will depend largely on the nature and situation of the adhesions and the areas of lung involved. An adherent apex, for instance, could not be greatly influenced by the removal of a few ribs along the side of the chest.

A limited resection, however, of two or three ribs near the apex can be done with perfect safety, under local anæsthesia if desirable, and may be of much service, especially if supple-

FIG. 1.
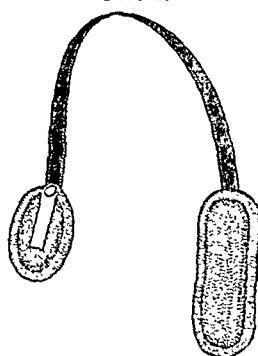
Truss for external pressure on wall of thorax after resection.

mented by external pressure in the manner to be described. The chest wall can in this way be caved in directly over the seat of the disease, where most needed, thus favoring shrinkage of cavities and healing by fibrous contraction. In spite of contrary statements I am convinced that much good cannot be obtained in such cases by costal resection elsewhere, or by the production of an artificial pneumothorax, owing to the resistance to collapse presented by the thickened lung tissue reinforced by a rigid, adherent thorax.

This procedure should not be applied indiscriminately, but should be reserved for refractory cases with marked and limited apical lesions, especially when a tendency to the formation of cavities exists. It should also be of service as an adjunct to an artificial pneumothorax, when there is reason to believe that the trouble in the apex is of such a character that it will

be but little influenced by collapse of the remainder of the lung.

In this operation two or three inches are removed from the second, third, and possibly fourth ribs, below the clavicle; and if it seems to be desirable, the cartilage of the first rib may also be divided in the manner suggested by Freund. This much has been done now and then with varying results for many years, for instance by Macewen, of Glasgow. Occasionally the periosteum was removed, and often it was allowed to remain, but as far as I have been able to ascertain, external pressure was never employed.

FIG. 2.   FIG. 3.
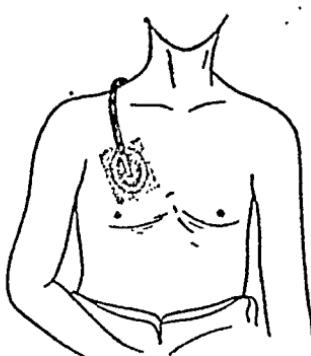
Thoracic truss applied, anterior view.   Truss applied, posterior view.
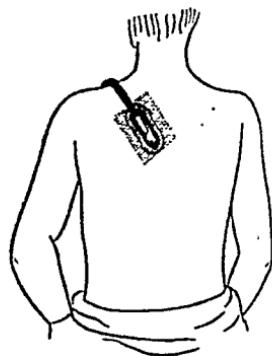
When the periosteum is *not* removed the ribs usually reform quite rapidly; hence, seeing that retraction and healing are slow processes extending over months at least, the utility of the operation is necessarily limited unless collapse is hastened by external pressure. Even when the periosteum *is* removed, at the expense of increased operative risk, the thickened and sometimes almost cartilaginous pleura must retard the cure.

It occurred to me some years ago that collapse of the thoracic wall might be materially hastened and increased by the application of external pressure by means of a truss. In order to accomplish this the second and third ribs are resected through a flap-incision, and after the wound has healed and lost its sensitiveness, a bunch of gauze is placed over the part

and an ordinary spring-truss adjusted so as to make consider-able pressure, the pad of the truss resting in front and the spring passing over the shoulder to the back, where it obtains its counter-pressure. An ordinary truss with a good spring and an adjustable pad will answer the purpose, although it may be advisable to shorten the spring and add a large flat pad to fit the back. The pressure can be increased to the point of tolerance, either by increasing the thickness of the gauze pad or by altering the curve of the spring. The apparatus need not be uncomfortable when properly adjusted.

. It is surprising how quickly and decidedly the chest wall can be caved in by this simple and safe procedure, leaving a saucer-like cavity, in spite of the fact that the periosteum of the ribs has not been removed; in fact the preservation of the periosteum may be of some service, in that the re-formation of bone may help to retain the full depth of the depression. Another service which the truss renders is to assist, by its constant firm pressure, in the local immobilization of the thorax, thus placing the lung more nearly at rest.

Recovery from a tuberculous lesion is necessarily slow, especially if a cavity is present, and may be protracted over many months, even under the most favorable conditions; hence marked improvement should not be looked for too soon. And it must also be understood that an operation is but a factor in the cure and perhaps not even the most important one.

I have employed this operation in but two instances, but in both the results were encouraging. The case-histories are briefly as follows:

CASE I.—A young man of nineteen, an inmate of The Denver National Jewish Hospital for Consumptives, who had been afflicted with hemorrhagic phthisis for about four years. Quite a large cavity existed in the left lung just below the clavicle, from which several ounces of yellowish, nummular sputum were expectorated daily. He was weakened and emaciated and there was no tendency towards improvement. Portions of the second and third ribs were removed, truss-pressure applied, and a marked depression rapidly produced. Decided improvement was

noticed in about five months. At the end of twelve months the nummular sputum had practically disappeared and has not returned up to the present time—about eight years. The general health has also undergone marked improvement, although he is still tuberculous. It is worthy to note that some months previous to the above intervention a spontaneous pneumothorax had occurred, followed by an empyema, for which an extensive Estlander operation was done. Although perhaps two-thirds of the lung had thus been collapsed, no curative effect upon the cavity resulted until the chest was caved in at the apex.

CASE II.—A man of 45, who had had phthisis for twenty-five years (patient of Dr. Alfred Mann, of Denver). A large cavity existed at the right apex, reaching down to the third rib, from which a characteristic expectoration of several ounces took place during the twenty-four hours. About three inches of the second and third ribs were removed and truss-pressure applied, which caused a rapid sinking in of the chest wall. In about five months a decided improvement had taken place, the nummular sputum being reduced to a small quantity. There has been no re-formation of the cavity at the end of 7 years and the general condition of the patient remains much improved, although there are still evidences of the presence of moderate pulmonary tuberculosis.

Conclusions.—1. The healing of stubborn tuberculous pulmonary lesions is favored by collapse of the lung.

2. This may be obtained by (*a*) artificial pneumothorax; (*b*) extensive extrapleural resections of all of the ribs, with removal of their periosteum; (*c*) local resections of ribs, especially at the apex.

3. The first method is not always applicable, owing to adhesions and to induration of lung tissue, while the second is difficult and dangerous, and should be employed under exceptional conditions only.

4. The third method is applicable to obstinate troubles at the apex, and can be employed alone or in conjunction with an artificial pneumothorax, according to circumstances. Its full benefit cannot be obtained, however, unless the removal of the ribs, which need not include their periosteum, is followed by the application of firm external pressure in the manner suggested by the writer.

THE TREATMENT OF FISTULÆ AND ABSCESSES FOLLOWING OPERATIONS FOR EMPYEMA OF THE THORAX.*

BY ALBERT J. OCHSNER, M.D.,

OF CHICAGO,

Surgeon-in-Chief of Augustana and Saint Mary's Hospitals.

ALTHOUGH the relative proportion of persistent fistulæ and abscesses is not so great as formerly after operations for the relief of empyema of the chest, since surgeons take the same precautions as in aseptic cases to prevent secondary infection during and after this operation, they are still sufficiently common to be a source of much annoyance to the surgeon.

There are, of course, other elements of value from the standpoint of prophylaxis, aside from that of aseptic operation and after-treatment.

The method advised by Murphy of aspiration and subsequent injection into the pleural cavity of 60 c.c. of a 2 per cent. solution of formalin in glycerine and the plan of making tubular through drainage in case of operation instead of simply making drainage into the pleural cavity, should be mentioned especially. The former method of treatment makes the latter unnecessary in many cases, and the latter method reduces the number of persistent fistulæ and abscesses to a minimum, because it eliminates the formation of pockets.

In cases in which these sinuses or abscesses persist, however, in which formerly the method of Estlander and Schede gave the most reasonable promise of ultimate success, surgical treatment has often been most disappointing. It is just in this class of cases that the method introduced by Dr. Emil Beck has given the most satisfactory results.

The method consists in filling the sinus or pus cavity with one or two solutions of bismuth subnitrate and keeping this

* Read before the American Surgical Association, Philadelphia, June 5, 1909.

in position by plugging the outer opening with gauze. Solution No. 1 consists of one part of arsenic-free subnitrate of bismuth and two parts of sterile amber vaseline; solution No. 2 contains 30 parts of bismuth, 60 parts of amber vaseline, and ten parts of paraffine of sufficient hardness to give the mass a fair degree of firmness at the body temperature.

No. 1 is injected every second day until suppuration has almost disappeared, then No. 2 is injected in its place. The injections are repeated as often as necessary to keep the sinus or pus cavity constantly filled with the mixture. At first it is necessary to do this every day or every second day, then every third and so on until it may be necessary to inject not oftener than once a week or ten days.

The Table on pages 154, 155 and 156 gives a list of fourteen cases in which we have employed this form of treatment, and it shows results which are much better than those we were able to obtain previously.

One feature has been most striking. In cases which were in a septic condition when the treatment was commenced, the improvement of the general condition of the patient was especially marked. Pulse and temperature became normal within a few days and the general appearance of the patient lost the characteristics of sepsis. The nutrition improved and the anæmia disappeared rapidly. The discharge from the sinuses usually becomes sterile in a short time.

To illustrate this a short abstract of the history of Case V will be typical.

A. S., an Italian laborer, 60 years of age, had a pneumonia followed by empyema of the right thorax, seven months ago. The pleural cavity was drained; a sinus persisted, leading into a large cavity. Three months later Estlander's operation was performed with excision of three ribs. The patient was in a severely septic and anæmic condition when he entered the hospital October 5, 1908. An injection of 720 c.c. of mixture No. 1 was given and the patient put to bed. In two days 60 c.c. more was injected, but by this time the septic condition had markedly decreased, and within a week the patient became normal and

his anæmia began to disappear. For one month injections were made every second day, the quantity in the meantime decreasing to 35 c.c. and the patient acquired a rosy appearance. Then he was sent home,—at first, to return twice a week to have a few c.c. of No. 2 injected, and later only once a week, a sufficient amount being used each time to fill but not to distend the cavity.

At present, June 1, his general health is perfect and there is but a superficial sinus which holds scarcely 5 c.c. of the paste, and which will undoubtedly heal completely in a short time.

A second case, No. 3, seems worthy of special description because it is one of the cases that were formerly extremely difficult to heal.

History in Abstract.—F. C., American, age 35, miner, had a severe fall nine months ago while working in the mountains; this was followed by pneumonia and then by a right sided empyema. This was drained through a rib resection opening. Seven months later an Estlander operation was made, with resection of three ribs. At the end of two months the patient came under our care—November 24, 1907. At this time there was a sinus discharging pus freely, and the patient coughed up the same material. This was before we were familiar with the bismuth paste treatment—so we performed Schade's operation. The patient did well for nearly a week, when he developd a phlebitis in both femoral veins. He became markedly septic and emaciated. Four weeks later he still expectorated pus, and there was a free drainage of pus from the wound when we began the injection of No. 1 bismuth paste. He expectorated much of the 650 c.c. of the paste we injected. We repeated the injection, each time simply filling the cavity without using any force. The pus and the sepsis subsided rapidly. In ten days he appeared like a different person, and in twelve weeks he was perfectly well.

I have used this method in fourteen cases at the Augustana Hospital in the treatment of sinuses or abscesses which have persisted after operation for the relief of empyema of the chest. Three of these cases had been operated twice and one three times before this method was employed, without obtaining a cure. Of the fourteen cases all but two, which are still

SYNOPSIS OF CASES OF THORACIC FISTULÆ TREATED BY BISMUTH PASTE INJECTIONS

Number	Hospital number	Sex	Age	Admitted	Discharged	Date of primary operation	Date of second operation	Injection of bismuth paste	History	Result
1	19986	F	11	Dec. 27, 06	June 27, 07	Dec. 29, 06	....	Had 12 injections of paste every 3rd day 1 to 3 ounces beginning Jan. 21, 1908	At time of operation, Dec. 20, 1906, 500 c.c. of pus evacuated. Empyema followed attack of measles. Through and through drain was placed. Sinus persisted two years when injections were used	Sinus closed completely after 12 injections.
2	21933	F	69	Oct. 10, 07	Feb. 17, 08	Oct. 12, 07	....	Injected with paste every 3–4 days from March 19, 1908 to February 22, 1909. 1–4 ounces	Empyema followed attack of pleurisy of 3 months duration. Three ribs resected but sinus persisted and patient returned 1 year later for injections	After 24 injections practically closed and patient returned home.
3	22220	M	25	Nov. 24, 07	Mar. 29, 07	Mar. 14, 07	Oct. 4, 07 Nov. 24, 07	Injections began December 20, 1907. First injection 20 ounces; second injection 12 ounces. After this varied from 2 to 8 ounces	Empyema followed pneumonia. Resected portion of 3 ribs, 7 months later had profuse discharge of pus and 6 weeks later greater portion of 6th, 7th, 8th and 9th ribs were removed. Patient still remained septic	Patient showed marked improvement after first injection, making rapid recovery. At end of 3 months wound perfectly healed; 38 injections given.
4	23120	F	16	Apr. 15, 08	June 13, 08	Apr. 16, 08	....	Injections began June 25, ended August 8; amount from 1 to 4 ounces; intervals 2 to 6 days	Empyema of chest following in grippe. Portion of 8th rib resected and about 30 ounces pus evacuated. Through and through rubber drains. Patient left hospital June 13, 1908; drainage remained rather profuse. On June 25 returned to hospital for bismuth treatment	Patient gained rapidly from time of first injection, and August 10, 1908 wound was completely healed. About 1 injections were given.

		Sex	Age					Injections	History	Result
5	24315	M	60	Oct. 5, 08	Oct. 22, 08	Mar, 08	July, 08	Injections began October 5, 1908. 12 ounces injected daily for 5 days. After this 1 to 3 ounces every 4th or 5th day	Empyema of chest following pneumonia. Both operations done elsewhere. On admission to hospital 4 months after second operation, had profuse discharge of pus from chest	Made satisfactory progress. At end of 6 weeks was practically no discharge of pus. Sinus almost closed. Holds only 5 c.c.
6	24497	M	28	Oct. 28, 08	Mar. 4, 09	Oct. 29, 08	....	Injections began November 10, 1908. Quantity 3 to 12 ounces, interval 2 to 6 days	Empyema of right chest, following stab wound on September 20, 1908. On admission patient was in a septic and greatly emaciated condition. Portion of rib (6th) resected and drainage established	Patient gained rapidly after beginning of injections. Is back to normal weight. Sinus not completely closed June 1, 1909.
7	24674	M	18	Nov. 23, 08	Feb. 10, 09	June 28, 09	Nov. 24, 08	Injections from December 12, 1908, to February 10, 1909. 1 to 2 ounces every second or third day	Empyema following pneumonia. Rib resected June, 1907. Profuse discharge of pus until admission November 24, 1908. 3 ribs resected and through and through drainage placed	Patient made satisfactory recovery and sinus was closed at time of discharge from hospital, after 25 injections.
8	24694	F	20	Nov. 25, 08	Dec. 27, 08	Nov. 25, 08	....	Injections began December 25, 1908 and continued to February 4, 1909, at intervals from 2 to 6 days. Amount, 1 to 4 ounces	Empyema following pneumonia. Resection of 7th rib on right side and large amount of pus evacuated. Through and through drainage placed	Patient made very satisfactory progress, with complete recovery at end of 12 weeks.
9	24717	M	41	Nov. 29, 08	Dec. 24, 08	Nov. 29, 08	....	Injections 1 to 2 ounces every second day from December 5, 1908, to December 23, 1908	Empyema of right chest. Right 9th rib was resected and 25 c.c. pus evacuated. Colon bacillus and streptococcus	Patient gained rapidly and left hospital 25 days after operation. Sinus in chest still open. Has healed entirely June 1, 1909.
10	25024	M	18	Jan. 19, 09	Mar. 19, 09	Jan. 20, 09	....	Injection from February 19, 1909, at intervals from 1 to 3 days	Empyema following pneumonia. Resected part of 7th rib, left side. Evacuated about 40 ounces of pus. Drainage placed	Made very rapid, recovery. Small sinus present at time of discharge from hospital, but no discharge of pus. Entirely healed June 1, 1909.

SYNOPSIS OF CASES OF THORACIC FISTULÆ TREATED BY BISMUTH PASTE INJECTIONS—*Continued*

Number	Hospital number	Sex	Age	Admitted	Discharged	Date of primary operation	Date of second operation	Injection of bismuth paste	History	Result
11	25117	F	8	Feb. 1, 09	Apr. 5, 09	Feb. 3, 09	....	Injections began February 20, 1909, at intervals 1 to 3 days. Amount 1 to 3 ounces	Empyema following pneumonia. Resection of 4th and 5th rib. Evacuated 12 ounces of pus. Drainage placed	Complete recovery at end of 9 weeks.
12	25195	M	45	Feb. 12, 09	Still in hospital	May 19, 08	Feb. 15, 09 Apr. 2, 09	Injections begun February 20, 1909. Continued at intervals 1 to 3 days since	Tuberculosis of 4th rib. May, 1908, a sinus was curetted. February 15, 1909, excision of 4th and 5th ribs. Tuberculous. April 2, 1909, 4th, 5th, 6th, 7th and 8th ribs left side were resected and about 16 ounces of pus found in pleural cavity. Cavity drained and later injected with bismuth paste	Patient greatly improved; still in hospital. Present discharge slight.
13	25212	F	4	Feb. 16, 09	Apr. 7, 09	Feb. 18, 09	....	Injections began March 1, 1909. 2 to 4 ounces every day for 4 weeks	Empyema following pneumonia. Resection of right 7th rib and evacuation of 12 ounces of pus	Complete recovery at end of six weeks.
14	25816	M	24	May 10, 09	Still in hospital	July, 05	Aug., 05 June, 07	Injections began on admission. 6 to 8 ounces injected 3 times a week since	Empyema following pneumonia. In July, 1904, after 3 operations, sinus still persists with profuse discharge of pus. At last operation 4 ribs were resected	Patient gaining in weight. Pus discharge greatly diminished.

under treatment, have been cured, and these two are making satisfactory progress.

This treatment has proven most satisfactory in our practice. We have used it only in cases with sinuses, although it has been suggested to aspirate the pus in empyema and to inject the paste into the pleural cavity through the trocar.

There has been no case of bismuth poisoning in our series of cases, although this might easily occur—as it has when cavities in other portions of the body have been filled with large quantities of bismuth paste. If this occurs, Beck advises the immediate injection of hot olive oil, 110° F., which will dissolve the paste and facilitate its escape through the outer fistula·or through a drainage tube, which may be inserted.

The injection is made with a large, ordinary glass syringe, just enough force being employed to fill the sinus or cavity, but not enough to cause forcible distention. The outer opening is carefully plugged with sterile gauze.

EMPYEMA THORACIS.*

BY ALBERT VANDER VEER, M.D.,

OF ALBANY, NEW YORK,

Professor of Surgery in the Albany Medical College.

IT is safe to assert there are few lesions where the physician and surgeon are called upon to assist each other in diagnosis and treatment, more interesting, and, at times, more difficult, than effusions within the pleura. Plastic pleurisy may have its surgical complications, but it is largely a medical condition, and one wherein the surgeon is not so much concerned. The serous effusions, however, present an entirely different history and line of procedure. Few conditions give so entertaining a solution of questions that, seemingly, forty-five years ago, were so hidden and mysterious, studied at that period, and even for two decades later, with the firm belief that surgical intervention was too dangerous to undertake. As one recalls these early impressions one cannot but feel encouraged over the fact that in this line of investigation operative surgery has made advances commensurate with the pathology and technic of other important branches of our art. It is not my province to discuss why a serous effusion in one case—where one-fourth, one-half or even more of one side of the chest may be involved—may continue for months, or even years, without any evidence of pus being present, and yet another case with the same clinical history may in a few weeks or months terminate in pus and present the condition we term empyema.

The only argument I have to offer in presenting this paper is my personal, practical experience. The point I wish to bring out is the change, in my time and in the memory of many members of our profession here to-day, in the surgical treatment of these cases. The willingness with which the general practitioner encourages the surgeon to approach these cases to-day, compared with four, three or even two decades

ago, is comparable only to the advance that has been made in the treatment of lesions of the appendix, the gall-bladder and other organs within the abdomen; yet it cannot be said that this change is entirely due to the aseptic surgery that has permitted us to invade the peritoneal cavity so boldly, for the technic of the two operations is very different. My early recollection of surgery of the chest presents a strong contrast with what we are now doing so fearlessly. Then, when once it was determined to evacuate fluid from the pleural sac (almost invariably pus) what precautions were demanded! We had had it impressed upon us by such splendid men as Trousseau and others, as early as 1846, and again in 1864, that the operation for paracentesis was an exceedingly grave one, and should be had recourse to only " when there is danger to life from immediate suffocation, or when the effusion is very large." Marrote, writing at the same time, gives a clear distinction between serofibrinous and purulent effusions and states, " that the radical operation of incision is the only one in purulent effusions that is at all likely to lead to a cure," and he was right, yet how very slow were our surgeons in following this advice. How well do I call to mind the discussions in our societies on up to 1880, as to the manner of treating effusions within the chest, in reference to evacuation and the entrance of air. In my early years of practice I had read Bowditch's discussion of the subject, presented as early as 1852, in which he advocated aspiration, and its application to all thoracic effusions; later another paper, published by him in the *American Journal of the Medical Sciences,* in 1864, in which he denies " that any ill results are likely to follow, or that purulent effusions cannot be effectually withdrawn through the capillary tubes provided for that operation." These were convincing contributions, yet how many suggestions were made at this time controverting his views! One very ingenious method was that of fastening about the cannula a portion of rubber tubing, or rubber dam, in such a manner that a trocar could be introduced and withdrawn under water, and the operation performed in such a way as to

exclude the entrance of air into the chest cavity. This was a method that was advocated with a good deal of earnestness. My study of Bowditch's papers, and the experience I had had during the Civil War, led me to believe that these cases required free drainage, and·that this fear on the part of the physician, and his unwillingness to yield to the advances of the surgeon's experience, would pass away; yet how slow was the progress. The method of simple aspiration carried with it such a high mortality that aseptic surgery was hailed as a factor of great assistance, and incision was encouraged, but only with the employment of the strong carbolized spray. I have often seen this used, and compelled myself to make use of it, because of the pressure brought to bear by the attending physician, who wanted Listerism carried out to the utmost, and yet how clearly would nature demonstrate her ability to take care of the chest cavity if only a free opening were provided! In 1864, Dr. Howard, of the United States Army, was permitted to go to the front to treat gunshot wounds of the lung by immediately sealing the wounds of entrance and exit with collodion, then applying firm compresses over the chest, the object being to exclude the air. I had an opportunity of witnessing this procedure in several cases, and in every instance if the effusion of blood did not force the dressing the accumulation of pus would be such that the dressings would become saturated and nature would assert her desire for free drainage. At that time I considered thoughtfully the *few* remarkable cases, such as that of General Shields during the Mexican, and others, in which it was said a silk handkerchief was passed through from one opening to the other, recovery following, and it seemed to me that Dr. Howard's method would soon be counted a failure, which it was within a very short period. However, I did not make use of my impressions afterward, in civil practice, for the opinion of the general practitioner with whom I came in contact was opposed to any such procedure as a free opening into the chest, but Dr. Bowditch's views were gaining ground and were bound to prevail.

Among the number of gunshot wounds of the chest and perforation of the lung treated successfully by myself during the Civil War, the following is most typical:

Lieut. A. N., 66th N. Y. Vols., æt. 21 years, July 21, 1865, while with his company, in trying to control a riot, was struck by a Minie ball, which entered the cavity of the thorax between the sternal end of the left clavicle and the second rib, without fracturing either. The wound was received while advancing towards the person firing, who was not more than fifteen feet distant. This bullet passed directly through the apex of the lung, making its exit just above the spine of the scapula, fracturing the latter bone severely. He was wounded at six P.M. and I saw him about a half hour later. The patient was bleeding very freely, expectorating blood, respiration extremely difficult, pulse rapid and hard to count; pupils largely dilated; suffering much pain. I immediately gave him ¼ gr. of morphine, continuing the same as needed, at the same time giving as much brandy as he could swallow—in all about six ounces during the night. Ice compresses were placed to anterior wound, and hard linen ones to posterior exit of ball. Two minims of tincture of aconite were given every two hours next day, with small pieces of ice in mouth to allay thirst; patient kept absolutely quiet on back; apparently little hemorrhage, and no blood expectorated; no color in face or lips; very anxious expression; passed urine in small quantities and infrequently. More comfortable during second night, but somewhat delirious. Pulse 120–130, short and quick, feeling the effects of stimulus; catheter necessary to relieve bladder of a large quantity of urine; no desire to move bowels; very restless third night, starting suddenly and saying he would die if something was not done for his relief. Under assuring words and medicine he quieted down. Complained of bed feeling hot; changed same, but not his shirt in which he was wounded. He had bled sufficiently to saturate two thick hair mattresses, and blood was beginning to drop to the floor. Fifth day expression improved somewhat, and pulse, under aconite, reduced to about 100; respiration easier. Air passed in and out through both wounds when compresses were removed. Evidently a large branch bronchial tube had been injured. Same general treatment continued until June 28, eighth day. when aconite was dis-

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continued. Bowels moved and patient passed urine freely in normal manner; appetite good; partook freely of beef tea, soft cooked eggs, etc. Patient had been a prisoner for several months in rebel prison in 1864–1865, and we feared a return of the chronic diarrhœa he then suffered from. Free discharge commenced at this time, June 28, from both wounds, at first clotted blood, then pus. Wound was kept clean by frequent washing with soap and warm water and a saturated solution of chlorinate of soda, also the use of a silver drainage tube posteriorly. July 12, general condition much improved; no secondary hemorrhages; treatment continued about the same; very small amount of stimulant given. Anterior wound healed; pus still discharging from posterior wound; there seemed no way of measuring the quantity, yet it saturated a large pad and the back of his woollen shirt twice in twenty-four hours. Morphine in divided doses during the night to make him rest easily; tincture of iron continued, and some color in lips, but not much in face and his hands were pearly white. July 15, in A.M. had a decided chill, not very free perspiration following; entire loss of appetite with some looseness of bowels; reason to fear pyæmia; gave free doses of quinine and stimulants. Chill did not return and in a few days he felt better.

July 28, I removed several portions of the necrosed scapula; respiration good in lower lobe of left lung; lack of it, with entire dulness, on percussion of upper lobe. Discharge from posterior wound enormous.

August 3, patient can now sit up in bed and is able to be moved to his home in Westchester. The journey did not seem to exhaust him a great deal. He did well for about a week when a severe attack of dysentery came on and reduced him rapidly. This yielded to treatment, and without further hindrance he continued to improve, and in a month was able to leave his bed. The discharge of pus continued quite freely for a time but gradually ceased, and on October 15 the posterior wound had healed entirely. Marked depression under left clavicle and some drooping of left shoulder: auscultation and percussion showed little use of upper lobe of left lung. He began a gradual course of exercise, continued his good diet and improved very rapidly.

July 4, 1866, I was surprised to see what a complete recovery he had made. He had entire use of the lung, except a small portion of the apex, apparently just above the track of the ball.

There are some points of particular interest in this case:

1. As to the great amount of blood lost, and the probable result had the wounds been closed in accordance with Dr. Howard's method, and the blood allowed, or forced, to remain in the cavity of the thorax.

2. The enormous quantity of pus discharged and in spite of this the ability of the patient to keep up.

3. The entire recovery of lung after it had been so long out of use, or in a state of collapse. In this case there was marked empyema. We attempted relief from this condition by using a silver tube and keeping the wound in a dependent position, which I think was most beneficial.

In January, 1909, I had an opportunity of examining this wound, at Los Angeles, Cal. The Major had been living in southern California for two winters, the climate appealing to him as affording more comfort than that of New York. Scarcely a scar could be seen at the point of entrance and exit. He had perfect use of his arms, and Dr. Poddinger, who was so kind as to examine him, assured me the lung was quite normal in its function.

This case in my earlier years gave me much comfort in the treatment of cases of empyema, traumatic ·or otherwise.

As late as 1878, Powell, who was one of the best authorities at that time, in writing upon the subject of empyema said: " As it is clear that we cannot empty the pleura even in recent cases without admitting air in place of fluid, we must adopt one of three methods: (1) Either to disinfect the air admitted into the pleura, and having inserted a cannula, to close the wound with antiseptic dressings to be renewed with the same precautions every three or four days;.or, (2) to make a double opening and introduce a drainage tube, so as to permit the escape of pus as rapidly as formed; or, (3) to make a single incision or free opening and insert a tube through which the pleura can be daily washed out with some disinfecting fluid." Of these three methods he says the first is to be preferred. At this period, or about 1880, and for the next five years, the discussion that older physicians gave the treat-

ment of empyæma, either by tapping or drainage, and finally, much later, by resection of the ribs, was most strenuous. My own experience with individual and older physicians was most emphatic. Occasional reports of a single case, by earnest operators, such as Martindale, of Port Richmond, presented in the *American Journal of the Medical Sciences*, July, 1881, were well worth studying, and illustrated the good effect of through and through drainage. In the *Medical News*, May 7, 1887, Dr. Strickler of Colorado Springs presents a most interesting paper on resection of the ribs and the treatment of empyema, but at this late period the old theories were in his mind, for here he states, " that no disturbance was caused by the admission of air into the chest cavity."

In my own mind, the decade from 1880 to 1890 presented a period of time when I had worked out the treatment of pleuritic effusion, and it has been my guide since. Antiseptic surgery, by means of the carbolized spray and aspirator, was not practicable in the treatment of such cases, and this became my formula: In a diagnosis of pleuritic effusion, when the temperature and pulse indicated that the fluid was yet sterile serum, I have insisted upon a very thorough effort at medical treatment being made, such as the use of a thoroughly dry diet, local application of blisters, free evacuation of the bowels, outdoor exposure, and plenty of sleep, and I have seen many happy results, both in children and adults, the latter more particularly. When there is a rise in temperature, increase in the pulse rate, perhaps a chill, and later a marked leucocytosis, and the suspicion arises that pus may be present, I have always insisted upon a free evacuation, but I have had strange experiences occasionally. The evacuation of pus by means of the trocar would result in the recovery of the patient, and this case was held up as an illustration by many conservative physicians in the neighborhood as one in which even drainage by means of the rubber tube was not necessary. Any excuse was offered for non-operative intervention. This, however, was finally the ground of compromise: That if the trocar and the drainage tube did not bring about a good result within

a reasonable time, I was not willing to yield any further to the conservatism of the good and respected family physician. If, however, the fluid remains sterile I believe a small percentage of these cases will recover by judicious, repeated use of the aspirator, but when once pus is discovered the use of the trocar and introduction of the rubber drainage tube is admissible, having the opening as low down as possible, and keeping the tube within the pus cavity. This treatment in cases under twenty-one years of age gives a very large percentage of recoveries. Failing, however, at this time in life, and particularly after the age of twenty-five, in this line of treatment, then resection of one, two, three, or four ribs, two to five inches, becomes necessary.

I have a record of a number of cases of pleurisy associated with malignant conditions not only of the lung but of growths elsewhere, in which the patient suffered from the associated attacks of pleurisy, and where I have seen marked relief from simple aspiration, going no further in other cases than to introduce the rubber drainage tube.

Cases of double empyema have, in my practice, been very rare. Much has been said regarding the danger of syncope and death, in the evacuation of pus, in all cases, either double or single, but the only fatal case I have encountered was that of a boy four years of age, who was suffering from double empyema, who had little breathing space left, and was very nervous and frightened at the thought of having anything done. Local anæsthesia was attempted, but his struggles were so great we were finally forced to give him a general anæsthetic, and just as I was puncturing the right chest the little fellow collapsed and expired. It has been my custom to evacuate the chest with great care, always insisting upon the horizontal position of the patient, and I have seldom seen a case of syncope. This case was a sad one in many ways and not infrequently quoted by friends when a similar line of procedure was suggested.

The use of the rubber drainage tube as the sole dependence in the treatment of cases of empyema, especially in adults,

cannot be considered as a successful method. In children it is likely to produce more serious deformity, and adults, if they do not recover at once, undergo a prolonged illness. Unless the patient's surroundings are especially good, and the previous family history above all possible suspicion, I have noticed that tuberculosis, in many instances, presents as the final condition.

It is interesting to note how the cavity of the pleura is disturbed and the distressing cough and irritable conditions that present when the loss of the drainage tube takes place. I have been called to see these cases and have noticed the great disturbances that presented in a train of symptoms having a most depressing, unpleasant effect upon the patient and friends, but I have not yet met with a case in which a foreign substance eluded resection, an accident that ought not to occur.

That empyema has claimed many methods and a great variety of operations for its relief cannot be denied, but like many surgical questions the solution has been delayed through the tenacity with which the family physician would, in former days, adhere to milder surgical procedures; this, however, is finally passing away. Their views were greatly to be respected and their arguments for a conservative line of treatment of these cases met with some success, but I am convinced, and feel able to assert that there can be no longer any doubt that the sooner a case of empyema is relieved (that in a number of cases resection of the rib is really necessary), and that this line of treatment must prevail to a greater degree in the future than in the past.

In the washing out of the cavity, after resection, and when employing simple drainage by means of the rubber drainage tube, I have had my attention called to the unpleasant effect of the use of peroxide of hydrogen. This is to be expected, and long since I have counselled against this antiseptic, employing much milder preparations which do not give the patient so much distress.

I have observed with much interest the cases that have

come to me, and in which I have been called in consultation, where the patient had a rapid change from the formation of serous effusion into that of pus, and the general infection of the system, as illustrated by the following case:

M. R. æt. four years; history of tuberculosis on maternal and paternal sides. Case came under observation July 3, 1908.

Previous history: Supposed to have had enteric fever when an infant; a year ago suffered from quite a severe attack of whooping cough; ten weeks ago had an attack of measles, later followed by pneumonia. In the early part of the attack of measles patient had otitis media of right ear, and which soon discharged quite freely. About this time left knee began to swell, and a week later swelling of the right shoulder. At the end of five weeks drainage tube was introduced and pus drained from bursa of left knee and abscess about right shoulder. Two weeks later empyema presented and trocar used, with introduction of rubber drainage tube in right pleural cavity. Knee and shoulder improved but drainage from side not satisfactory. July 3, 1908, two ribs were thoroughly resected and an abscess containing about 500 c.c. of purulent fluid escaped. Drainage continued very profuse. From this time on patient improved rapidly and has made a splendid recovery.

That repeated cases of pneumonia often deceive the general practitioner, regarding the complication of empyema, and as to the possibility of tuberculosis being present, is, in my mind, a fact.

I have sometimes witnessed a very earnest discussion, on consultation, as to whether the case was one of simple plastic pleurisy, one of chronic consolidation, or one of true empyema, and I have no doubt in my mind that there are many cases of pneumonia associated with pleurisy in which an unexpected condition of empyema creeps in and is present without being recognized as promptly as it should by the family physician. The following case, one of many, is of some value in illustrating this point:

J. W., æt. 45 years, farmer by occupation. May 8, 1908. suffered from pain in right side, and in June had an attack of

pneumonia, same side. This was followed by attacks of coughing and pain on inspiration. Cough paroxysmal, which had persisted since onset, usually occurring during morning hours, at which time patient expectorated freely, coughing up profuse secretion, described as resembling oyster juice, with sweetish taste, but free from odor. At times he had expectorated a quart of this material, and not infrequently a pint or more. During attacks pain was present on right side of chest. Had lost in weight and strength. No history of night sweats; otherwise history negative. There was much discussion as to the case being one of tuberculosis or consolidation from pneumonia, possibly plastic pleurisy, but with no admission as to empyema being present. Blood count did not show a leucocytosis above 6250. Frequent examination of sputum showed an enormous number of pus cells, but no tuberculosis.

May 14, 1908, I believed the patient was suffering from empyema, and did a thorough resection of the fifth and sixth ribs, opening into a large abscess cavity with an adhesion to the fourth and fifth ribs and to the pleura that acted, as the lung had contracted, to give it the appearance of an hour-glass contraction. These adhesions were loosened and revealed a free opening into a large bronchus, also marked necrosis of the ribs. This cavity was well packed with three large tampons of sterile gauze and around a large rubber drainage tube. The patient made an uninterrupted recovery, cough abating at once, expectoration ceased, he gained rapidly in flesh and has made a good recovery, with the exception of a slight sinus, about two or three inches in depth which remained when he was last examined, April 1, 1909. The lung had returned to its normal condition regarding function. It is very impressive to note how cases of empyema will go on, the patients remaining invalids, and treated for one condition and another, but when at last reached are not unlike those of neglected appendicitis.

For some time I have discouraged the use of iodoform gauze as a dressing, and for treatment of the large cavity that remains after resection of the ribs I make use of either vermiform or just plain sterilized gauze. I believe it is well to pack the cavity somewhat firmly at first, so that the lung is not embarrassed by the lack of support, the patient is made

more comfortable, and then, at the end of forty-eight hours removed and packed much more lightly.

The use of the hypodermic syringe as a means of diagnosis is of vast help; the use of the aspirator in evacuating a chest that contains aseptic fluids is to be commended, and the use of the instrument can be repeated a number of times, but great care should be exercised in the laboratory examination of the fluid withdrawn, the least indication of pus that presents being a warning for the abandonment of this method.

I have been greatly impressed with the reports coming from the laboratory regarding the mixed infection that presents in cases of empyema, and how very seldom the bacilli of tuberculosis are found.

I have also been very much impressed regarding the length of time that pus has existed, or where the condition of empyema has been present, in the cases that have come under my observation, and of which the following are but illustrations of others:

G. F. C., æt. thirty-nine years, salesman by occupation, came under observation November 7, 1904. Patient had had diseases of childhood, during which time he was supposed to have had pleurisy.

Present illness: Four years ago was ill for three days with a diagnosis of pleurisy of right side. Recovered and apparently well for two years when an abscess presented to the right of right nipple, which was lanced, discharged quite freely, healed for some time, formed again later and discharged for six months. Then another abscess formed nearer nipple which was also lanced. This has been discharging ever since, and particularly profuse for past four weeks. Patient's weight has remained about the same. This abscess was very annoying in getting about to his business.

I advised resection of ribs, which was done November 8, 1904, resecting about four inches in length of fifth, sixth and seventh ribs, when an abscess was opened into, connecting with the sinus, abscess extending from apex of the lung to the diaphragm and having a capacity of about thirty fluid ounces. Lung completely walled off, and surface of the pleural cavity lined with a thick calcareous coating. The latter was dissected out as much as pos-

sible and cavity then packed with plain gauze around a large rubber drainage tube. Gauze gradually removed and drainage tube relied upon, through which irrigation was kept up, patient making a good recovery. January 6, and March 12, 1905, family physician, as well as patient, reported a steady improvement. Again in the spring of 1906 report came that he was doing well but a short sinus persisted. Lung had expanded well.

I have been interested in noting the phosphatic deposits that are found in long-standing cases of infection of the pleura, and I believe that better results come from attempting to dissect out, as carefully as possible, that portion of the thickened pleura which can be reached.

Cases of empyema or multiple abscess, particularly in children, are the ones to watch with prompt care, and we should not fail to make our operations thorough. I fear that at times we fail, perhaps, in giving full relief, as the following case illustrates:

M. H., æt. six years, came under observation February 12, 1904. Principal symptom that of a persistent cough and P.M. temperature. Family history negative. Whooping cough at the age of three years, followed by measles in the winter of 1901. This followed in turn by what was believed to be bronchitis which left her with a cough resisting all treatment and which has persisted ever since. May, 1903, had bronchial pneumonia, recovered and apparently well except for the cough. About four weeks ago child's temperature would rise at three P.M. to 102–103. This would persist until seven P.M., when it would gradually abate. Has been greatly weakened by a persistent diarrhœa. Appetite not good. In coughing raises nothing but white, mucus-like substance; no tubercular bacilli present on examination. About this time an abscess formed in right side of chest and discharged quite freely. There was much dulness on percussion, with zones of respiratory murmur. The case believed to be one of empyema unrelieved by the sinus, and an operation advised. Sixth and seventh ribs resected, one and one-half to two inches in length, and abscess cavity opened into just above the termination of the old sinus. Quite an amount of pus escaped and cavity packed with iodoform gauze. Operation fifteen min-

utes, under chloroform. Bacteriological examination at the Bender Laboratory showed cocci and bacilli, and cultures showed diplococcus pneumonia. Patient improved somewhat at first, was much more comfortable, but temperature gradually increased, reaching 107.6°, then declined to 105° when she died somewhat unexpectedly. No autopsy. I believe this patient was suffering from multiple abscesses and entire relief was not afforded.

The next case is somewhat in contrast:

I. E., æt. six years, came under observation January 9, 1905. September 21, 1904, had suffered pain in chest, vomiting, fever, loss of appetite and severe cold. Child treated for typhoid fever for five weeks. Previous history had always been good. Now another physician called who diagnosed empyema. Patient was sent to a local hospital, where two incisions were made in side, but with negative results. January 9, 1905, patient was brought to the Albany Hospital and resection of ribs determined upon, believing the child was suffering from empyema. Thorough resection of fifth rib done and cavity opened into very promptly. In introducing fingers two or three cavities were distinctly located and opened. Gauze tampon used for drainage for some few days, then rubber drainage tube, and irrigation. Respiration had been rapid but gradually dropped to twenty-four. Temperature for first few days between 100° and 100.5°, then gradually came down to about normal. This patient made a good recovery.

As a contrast to the first case of gunshot wound reported in this paper the following is somewhat interesting:

P. S., Hungarian, æt. 27, during a quarrel on the night of November 2, 1908, was shot in the right side and fourth rib severely fractured. He was brought to the hospital at once, and the same day my son, Dr. Edgar, opened the wound freely, removed a good portion of the rib, recovered the bullet, found pleura quite badly lacerated, some considerable hemorrhage, and wound packed with plain gauze around rubber drainage tube. Patient somewhat uncomfortable a few days after the operation; some difficulty in breathing; temperature at one time 103°, some purulent discharge, but all these conditions abated gradually and patient made a good recovery.

In the study of cases that have come to me, and in some of my own, I have been somewhat disconcerted by having them go on nicely after thorough resection of the ribs, but finally ending in a sinus that was exceedingly troublesome and difficult to close. For instance, Mr. D. gives a good representation of this condition, and upon this point I trust we may hear some discussion:

M. M. D., ætat 34, agent by occupation, had typhoid pneumonia ten years ago, followed by empyema. An abscess followed later and for eight years sinus in right side had persisted. He had kept this sinus open, which led from pleural cavity, and discharge very slight. April 24, 1907, patient very anxious for permanent relief, condition incapacitating him for work and he wanted to get well. General condition otherwise very good. He entered the Albany Hospital ánd resection to the extent of three inches was done in sixth, seventh and eighth ribs, in axillary line, right side, and quite an extensive abscess cavity was opened into. Patient went on to complete recovery, gained in flesh, returned to his work, and able to do as much as ever, but December, 1908, there was yet a sinus about four or five inches in length which would hold about one-half ounce, which would not heal under any form of treatment followed out.

In the chronic state of these sinuses I would be very glad to hear from any of our associates who have had an experience in the use of paraffin in the treatment of these cases.

In the treatment of sinuses I am quite sure that the drainage tube or method of drainage is somewhat responsible, that at times the packing is too earnest and the tube is left in too long, not granting sufficient opportunity for the expansion of the lung. Where the lung does expand rapidly a sinus is not so likely to form. This is one point I believe in favor of an early operation, therefore, I use it as an argument with the family physician to avoid delay in these cases.

In the study of my cases of empyema I have been greatly impressed to note what a large proportion occur on the right side.

As remarked, it is most impressive to note the duration of the history of cases of empyema and their association with what might be termed a tubercular predisposition.

J. W. B., æt. 39, a bottler by occupation, came under observation May 18, 1903. One sister had died of tuberculosis. Sputum thoroughly examined and negative of tuberculosis. Blood examination: Leucocytosis 8000, and many polynuclear leucocytes present. Patient gave a history of cough and expectoration of blood for fifteen years. Four years ago had a distinct pleurisy in left side, since which time noticed respiration had been difficult and somewhat rapid. November, 1902, contracted a severe cold and since then unable to work. His family physician made the diagnosis of empyema and did two aspirations, but with little benefit. May, 1903, an abscess was opened between eighth and ninth ribs, under ethel chloride, and a large amount of pus evacuated. On May 19 another incision was made with a somewhat similar result, but his symptoms did not improve, temperature not lessened, and he was advised to enter the Albany Hospital. May 27 I did a thorough operation and found a sinus that extended to the intercostal space between the eighth and ninth ribs, which was carefully dissected out, and which had communicated with the pleural cavity. Seventh and eighth ribs resected to the extent of nearly four inches, this opening into a large abscess cavity from which a pint of pus was evacuated. A large rubber drainage tube inserted and packed about with iodoform gauze. Gauze removed at the end of forty-eight hours and abscess cavity irrigated with boric acid solution, a drachm to the pint. After this operation his temperature became normal, cough ceased, appetite returned, general functions of the body became normal, and patient left the hospital at the end of the third week, improving in every respect and ultimately making a good recovery. I regret to say the hospital record fails to note and report on examination of sputum, on his discharge, for tuberculosis. His clinical history and appearance was that of tubercular trouble.

In a number of my operations for the relief of empyema I have seen good results following the bottle method of exercising the lung to produce expansion.

Summary.—1. That the hypodermic syringe, with a long needle, is of value for exploratory purposes.

2. That the repeated use of the aspirator is not to be condemned so long as the fluid remains sterile, and its use is the preferable method of treatment in malignant cases.

3. That the use of the trocar and drainage tube is advisable after it is shown that the aspirator is no longer affording benefit.

4. That resection of the ribs is absolutely necessary when no improvement takes place with the ordinary drainage tube.

5. The latter operation to be done early, in order to protect the lung from unnecessary pressure and to relieve the adhesions that, in the young, become so detrimental in causing spinal curvature. .

ŒSOPHAGOGASTROSTOMY AFTER INTRATHO-
RACIC RESECTION OF THE ŒSOPHAGUS.*

BY WILLY MEYER, M.D.,

OF NEW YORK,

Professor of Surgery at the New York Post-Graduate Medical School and Hospital; Attending Surgeon to the German Hospital; Consulting Surgeon to the New York Skin and Cancer Hospital, and New York Infirmary.

SINCE the last portion of the body, the thoracic cavity, has been definitely opened to surgery as a result of the introduction of the principle of operating under differential air pressure, the treatment of the diseases of the organs situated within the chest as well as the diseases of the chest wall itself, has, of course, become greatly facilitated.

Next to pleura, lungs and heart, it is the œsophagus that now can be safely attacked by the surgeon also in its thoracic portion. While access to the other organs named has been had before the advent of operations under differential pressure, there is great risk connected with such operations in view of the always threatening pneumothorax. Still there was at least a possibility of doing the work. It has been different with the œsophagus in its thoracic portion. This has always been a *noli me tangere,* at least as far as a direct route through the thoracic wall was concerned, and this owing to the fact that as soon as the œsophagus is lifted out of its bed both pleural cavities are liable to be opened. Thanks to the work of Sauerbruch and Brauer we now have access also to the œsophagus by the straight, direct route, with the same safety with which we approach the intra-abdominal organs.

Of the various diseases of the œsophagus it is principally cancer—this up-to-date inevitably fatal disease of the œsophagus—which has now been placed within the focus of surgical interest and attack. So far every single patient with malignant stricture has had to die of the disease. When such a case

* Read before the American Surgical Association, June 4, 1909.

came under our care, we usually took the family into our confidence, stating the helplessness of operative surgery in this particular affliction and admitting that the patient was absolutely doomed. The latter usually was told for humane reasons that a stricture existed between mouth and stomach, for which a gastric fistula would have to be established, to prevent death from starvation, and that, by feeding through the tube and giving rest to the diseased part of the œsophagus for a time, the constriction would probably yield within a few months. And when the "few months" had passed, the patient also was usually ready to pass away. Others condemned all operative treatment in these cases and kept the passage to the stomach patent with the help of bougies regularly introduced as long as this was possible, soothing the patient with hopes that could, of course, never be realized: And all this in dealing with a carcinoma, that may well be pronounced the most benign of all of them, one that has little tendency to produce early metastases, and affects the glands only when the border lines of the œsophagus itself have been transgressed by the disease. I say, all this with a carcinoma the presence of which, even in its early stages, can be diagnosed without much difficulty.

It was but natural that with the introduction of differential pressure operations five years ago great hopes were at once entertained as to our being able to take up at last the cudgels also against this disease and to combat it successfully.

While it may be disappointing that so far, out of about twenty patients operated upon for cancer of the œsophagus, by six different European surgeons, not one has recovered, it is to be regretted that such a small number of failures should have induced Sauerbruch to say in his latest publication on this subject, which appeared only two months ago (*Deutsche Zeitschr. f. Chir.*, vol. xcviii 2 and 3, March, 1909), that his hopes of obtaining success in operating for œsophageal carcinoma are greatly reduced and that the indications for operative interference must be drawn extremely narrow.

The cause of the unsatisfactory results has been: First the

great advance the disease had already made in most of the cases cited by him when they came under the knife; Secondly, the extreme sensitiveness of the pleura and especially of the loose connective tissue of the posterior mediastinum to the highly infectious mucous secretions of the œsophagus, and that in spite of the most rigid asepsis; Thirdly, the absence of a pleural cover to the lower third of the œsophagus; Fourthly, the lack of a safe method of operation.

Still, it seems to me that the only way to make progress in the direction of combating œsophageal cancer, is to go right on, regardless of past failures, endeavoring to improve our methods and to try to overcome the many obstacles; to encourage, rather than to discourage the profession as well as the laity to have an *exploratory thoracotomy* made in every instance, where the suspicion of the presence of an œsophageal carcinoma has arisen. That is the time when the attempt should be made to save the patient. Without operation the patient is absolutely lost; with it he has at least a chance.

Of course, if a major operation is refused, after exploratory thoracotomy has revealed a suspected carcinoma, the wound must be closed and the patient left to his fate. With the help of a gastric fistula his life may perhaps be prolonged, but his only chance of a cure has been irreparably and irrevocably lost. Here, as well as with cancer elsewhere, early diagnosis to be followed up with prompt and proper surgical intervention, is the all important point.

It is certainly true that personally, I cannot so far point to a single case of œsophagogastrostomy performed on the human subject. I have done but one exploratory thoracotomy for cancer of the œsophagus on a human, and my opinion may, therefore, not be of much weight when compared with that of our more experienced European colleagues. My deductions are made from the history of the operative treatment of cancer of the stomach. Did we not there too have difficulties to overcome, which in the beginning looked almost insurmountable? Did the first twenty mishaps in that field discourage us from continuing our efforts to obtain better results?

Think of the great mortality observed during the first years of gastrectomy for carcinoma and the greatly improved results obtained to-day. Surely, deductions based on but five years' work in attacking œsophageal carcinoma, the most difficult task in all surgery, can have no claim to being considered conclusive. Even should the first 50 or 100 or 200 cases operated upon for cancer of the œsophagus die, may be the 51st, 101st or 201st will live. They are lost anyway, and what a terrible death most of them do die!

When I commenced my research work in intrathoracic surgery on dogs at the Rockefeller Institute of New York City, in the middle of November, 1908, one of my aims was the finding of a method of œsophagogastrostomy after resection of the œsophagus, that would answer the requirements of everyday practical surgery, a method, which should come nearest to excluding the possibility of infection following the dividing of the œsophagus, insure a reliable approximation, avoid leakage after the approximation has been made and maintain the necessary patency of the canal.

I hope I have found a method which comes up to most, if not all of these requirements. In working it out, the leading idea has been to avoid penetrating the wall of the proximal stump of the œsophagus laterally. Only in this way is the surgeon able to prevent exit even of a drop of the highly infectious contents of the œsophagus above the stricture. There is no other way of accomplishing that than to implant the temporarily tied proximal stump of the œsophagus into the stomach.

In my work at the Rockefeller Institute I was assisted by Dr. Martin Rehling, my adjunct attending surgeon at the German Hospital. I gladly take also this opportunity of expressing to him my sincere thanks for his most faithful and able help and the many excellent suggestions he made in the course of our work. No less am I indebted to Dr. Edward Adams, formerly of the house staff of the German Hospital, now instructor in surgery at the New York Post-Graduate Medical School and Hospital, who, with an attendant, reg-

ularly conducted the general anæsthesia in my operations. Further members of the crew required for the work were, a nurse to hand instruments, sponges and dressings, and a man whose only business it was to attend to the setting of the valves and to the proper regulation of the differential pressure.

Before describing my operative method as I have evolved it in the course of my experimental work during the last six months, it would seem proper to say a few words on the apparatus used.

The portable chamber which Dr. Sauerbruch courteously left here for my use last summer, after he had shown it before the surgical section of the American Medical Association at its Chicago meeting in June, permits of work under positive as well as negative pressure. For operations under partial vacuum, everything required for an operation had, of course, to be taken inside of the cabinet before its door was closed; and, once the vacuum established, the door could not be opened again. Communication with the outside world was then cut off. Under this arrangement the anæsthetizer sat outside of the box. The chamber was so small, that with surgeon and assistant placed inside, it was impossible to maintain proper asepsis. Consequently I reversed the order of things, put the narcotizer inside of the chamber under increased pressure and doing my work outside of it under atmospheric pressure.

During all this time I proceeded with the getting up of a different kind of apparatus.

It was built for me under my direction and guidance by my brother Julius Meyer, an engineer by profession. The first completed specimen thereof was brought into the Rockefeller Institute on January 8, 1909. This new apparatus, a " Positive Differential Pressure Chamber," has a great many advantages over all other similar apparatus so far known. It will be fully described in a separate article.

I have used the apparatus for the last four months to my entire satisfaction.

An improved chamber of this kind, arranged with an air-

lock for the admission or exit of one of the two narcotizers in the course of the work, with the necessary machinery mounted on a small cart (power truck), was placed ·in the German Hospital early in March and has meanwhile been successfully tested there in a number of operations on human beings.

Next I had constructed a chamber in which it is possible to operate either under positive or under negative differential pressure, or under a combination of the two, and which, further, allows the changing from one pressure to the other in the course of one and the same operation, a thing unattainable with any one of the preceding apparatus. Formerly an operation had to be finished under the same kind of pressure under which it had been commenced.

Of this universal differential pressure chamber the aforementioned " positive differential pressure chamber " forms a part.

The universal chamber was completed in April and installed for me at the Rockefeller Institute by my brother at the end of that month. I have used it since May 7th and have been very much pleased with its smooth working. With the aid of this apparatus I will attempt to establish, whether there are indications for the use of negative or positive or a mixed pressure in the case of the diseased human being. The surgeon with his assistants and attendants remains therein in the same place, no matter which kind of pressure be used.

A detailed description also of this apparatus will soon appear in another article.

After this conversion into the developing of improved tools I will now proceed with the description of the work performed with the same.

When resecting the œsophagus, we must be mindful of the fact that this tube cannot be stretched for the purpose of approximating the two ends. The stomach must, therefore, be brought up into the thorax for anastomosis to the proximal portion of the œsophagus, while the distal end is closed and dropped back.

In operating for cancer of the œsophagus, two ways are open to the surgeon:

1. Gaining blunt entrance into the abdominal cavity next to the cardia; transposition of the stomach into the thorax; closure of the rent in the diaphragm by stitching it on to the stomach; resection of the diseased portion of the œsophagus; œsophagogastrostomy.

2. Resection of the diseased portion of the œsophagus; closure of both ends; gastrostomy for permanent feeding.

This method is indicated in cases in which the carcinoma has invaded the upper portion of the intrathoracic part of the œsophagus (behind the aortic arch, for instance). Usually the stomach will not be found sufficiently large, to be pulled up to this place.

Further experience is necessary to find out whether the operative closure of the upper portion of the œsophagus is as well borne. It may be shown that preference should be given to the establishment of an œsophageal fistula in an intercostal space. Still more preferable seems, to pull up a coil of the upper portion of the jejunum into the thorax, and perform œsophagojejunostomy, thus overcoming the annoyance of a permanent gastric fistula.

It is wise to start operation No. 1 with pulling up the stomach above the diaphragm. The amount of its yielding must guide the surgeon in his decision as to which of the two methods had better be employed. Of course, the first is the operation of choice.

The necessity of establishing a permanent gastric fistula for the remainder of the patient's life should not discourage the operator. The writer has a young man of 18 under observation, who was operated upon when a boy five years of age, for an impermeable cicatricial stricture of the œsophagus. The boy has since then, *i.e.* for a period of 13 years, been fed through the gastric fistula that had to be established, and has nevertheless grown up to be a fine strong man.*

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* *Cf.* Medical News, October 29, 1904, and ANNALS OF SURGERY, vol. xlix, p. 260, 1909.

The various steps of the operation as carried out and recommended by the writer to-day are as follows:

1. Incision best in the eighth intercostal space,* in order to be able to easily approach the cardia and determine whether the stomach can be properly pulled into the thoracic cavity. Rib spread or put in place (Fig. 1.)

Of course, before this, the seat of the disease which had previously been located with the help of the bougie, X-rays (bismuth), and œsophagoscope is investigated by direct palpation.

2. Lung pushed upward and inward by gauze tampons, and œsophagus, with nervi vagi and aorta running along its side, come into view (Fig 2).

3. The œsophagus is raised from its bed. The surgeon's left forefinger surrounds the œsophagus; nervi vagi stripped off. In doing this the opposite thoracic cavity is frequently opened. No harm results therefrom when working under differential pressure (Fig. 3).†

4. Œsophagus with cardia is pulled up by the left hand, thus putting diaphragm on the stretch. An anatomical forceps is pushed parallel with and to the right of the œsophagus into the abdominal cavity (Fig. 4).

5. By flexing second phalanx of thumb, which rests on the cardia, the stomach wall is rolled upward, grasped with anatomical forceps and then pulled into the thoracic cavity by hand (Fig. 5).

6. The rent in the diaphragm is grasped with a number of tenaculum forceps, care being taken to catch below the diaphragmatic peritoneum This point is of very great importance, as only by including this part of the peritoneum a rapid and thorough agglutination between stomach and diaphragm can be expected (Fig. 6).

7. Diaphragm stitched to stomach with the help of silk sutures, the assistant pulling on the forceps and the operator introducing his left

* In dogs the incision in the seventh intercostal space suffices to enable one to do the work including the resection of the œsophagus and the subsequent œsophagogastrostomy, provided only a short piece (not longer than an inch) of the œsophageal tube is excised. If a larger piece is removed, the work with needle and thread becomes unsafe, if not impossible, and a second intercostal incision a little higher up, say in the fifth or sixth intercostal space, will be required. Dogs stand this double incision very nicely. With the greater length of the human thorax this double incision also seems practical, if the surgeon does not prefer a flap formation or the removal of a number of ribs. The preliminary operation on the chest wall will have to be adapted to the individual case. In order not to have the two incisions too close together, I selected the incision in the eighth interspace instead of in the seventh, which latter has so far been preferred by other operators.

† The wearing of cotton gloves greatly facilitates intrathoracic work. These gloves always give one a firm hold on the organs, which are rather slippery to the bare hand, still more so, of course, when the hands are covered with rubber gloves. I have used cotton gloves in aseptic intrathoracic operations right from the start and should not like to do without them,

Fig. 1.
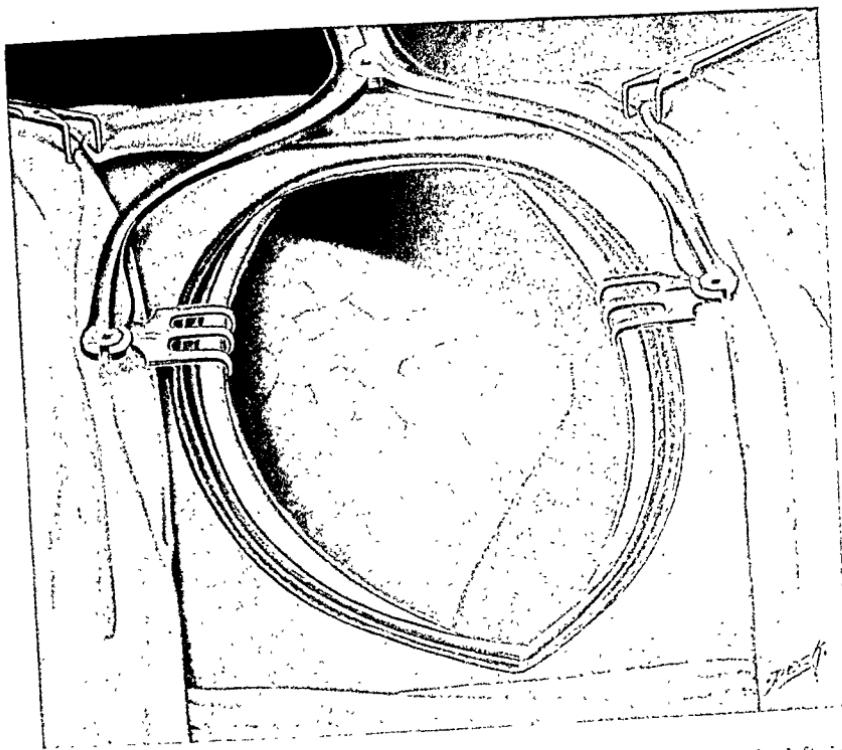
Intercostal incision in eighth interspace. Rib spreader in place; to the left, inflated lung as it presents itself under differential pressure; diaphragm to the right, descending aorta and ribs in the background.

Fig. 2.
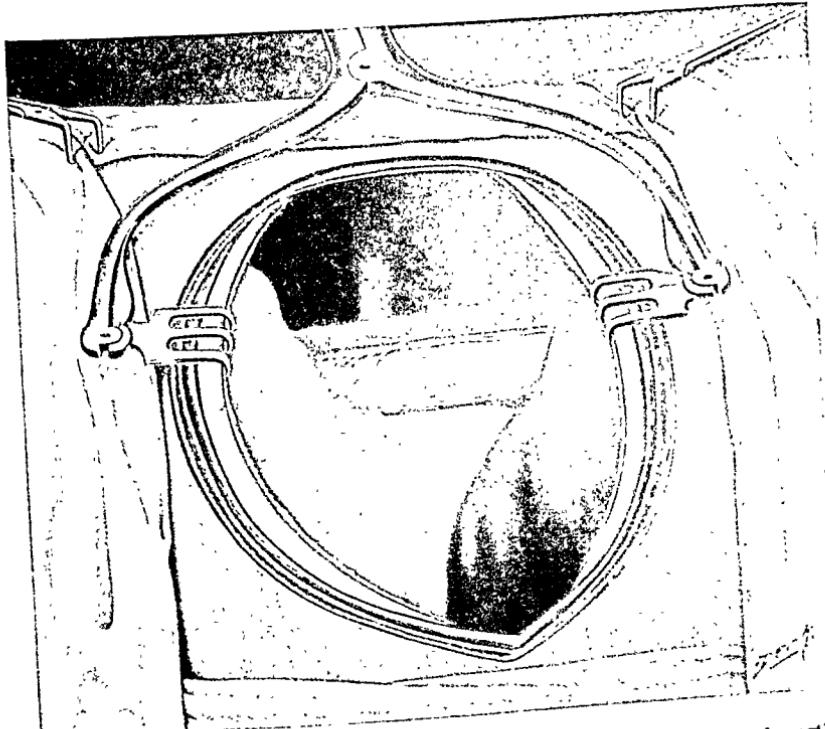
Lung pushed aside by gauze tampon; œsophagus showing in depth of wound, partly covered by pleura; nervi vagi on either side.
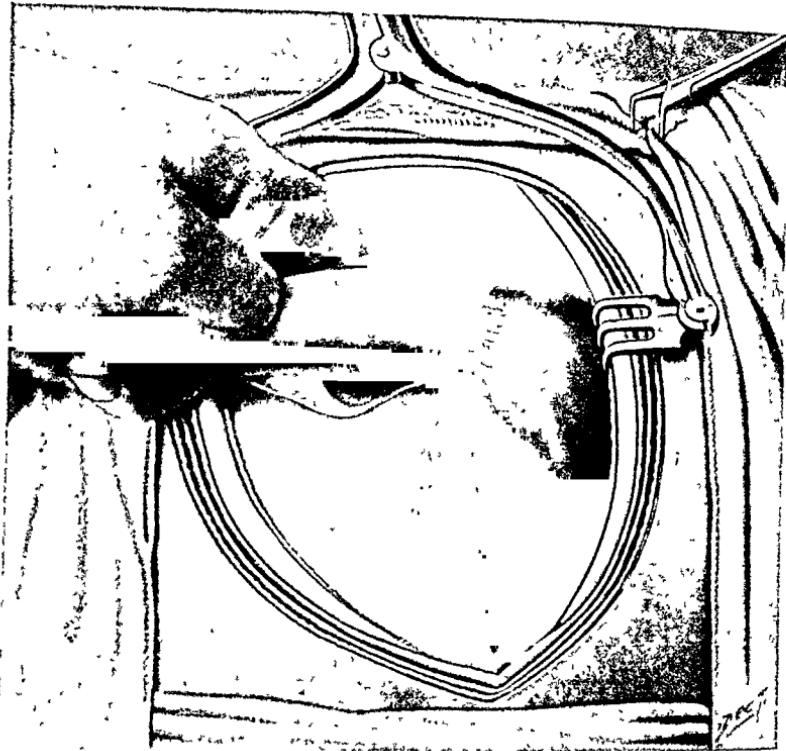
Œsophagus raised, surgeon's forefinger surrounding it.   Nervi vagi stripped off.

Fig. 4.
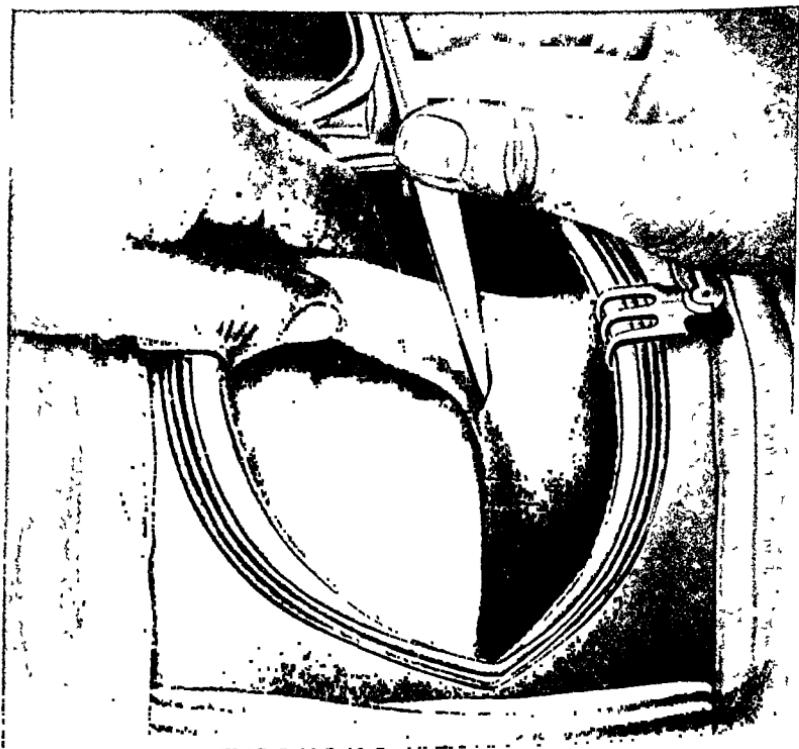
Œsophagus, with entrance to stomach, plus diaphragm pulled upward by left hand; anatomical forceps bluntly entering abdominal cavity to left of cardia. (Forceps in reality inclined more obliquely.)

Fig. 5.
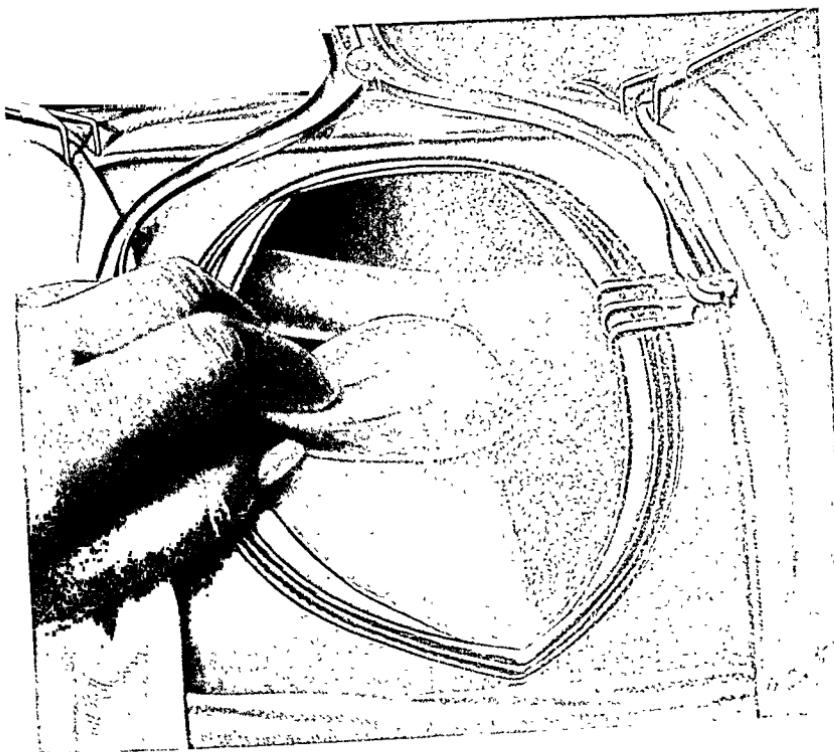
Stomach pulled into thoracic cavity.

Fig. 6.
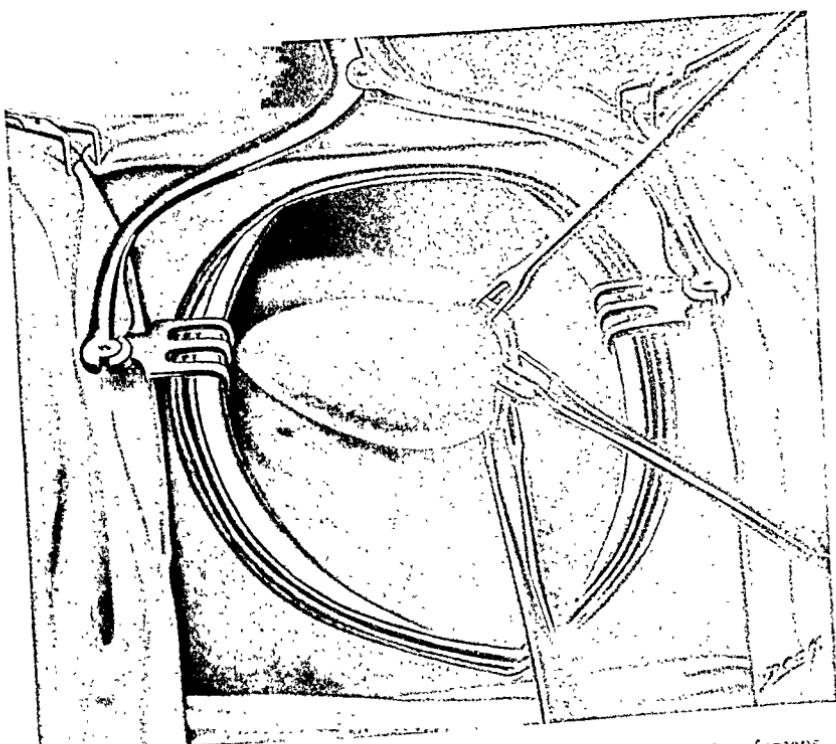
Rent in diaphragm, with diaphragmatic peritoneum caught by tenaculum forceps.
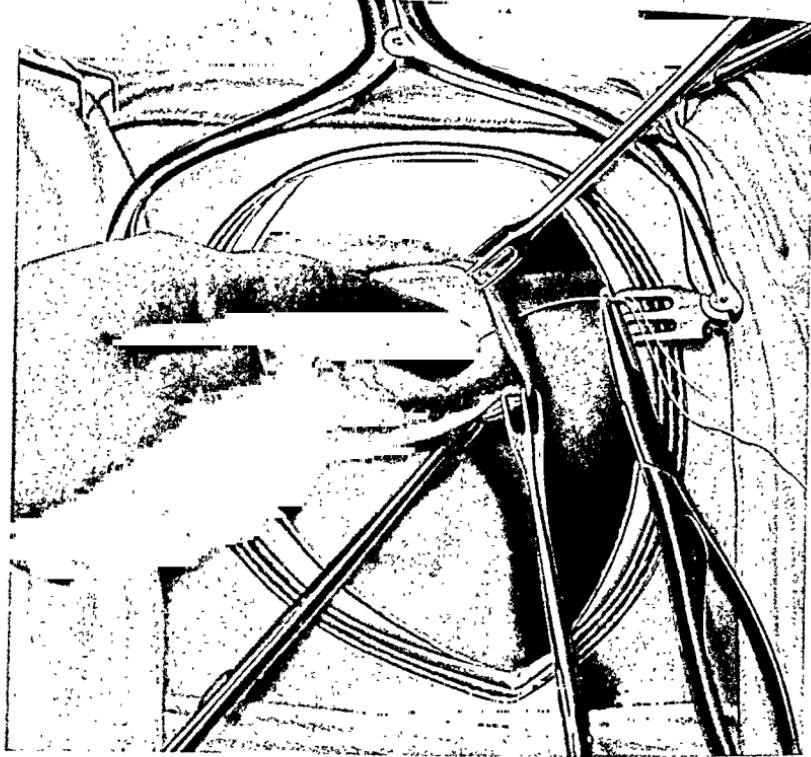
Silk sutures through diaphragm and wall of stomach. Surgeon's left forefinger emerging from abdominal cavity with tip of needle.

FIG. 8.

Forefinger surrounding œsophagus; circular incision of muscular coat to form cuff.

FIG. 9.
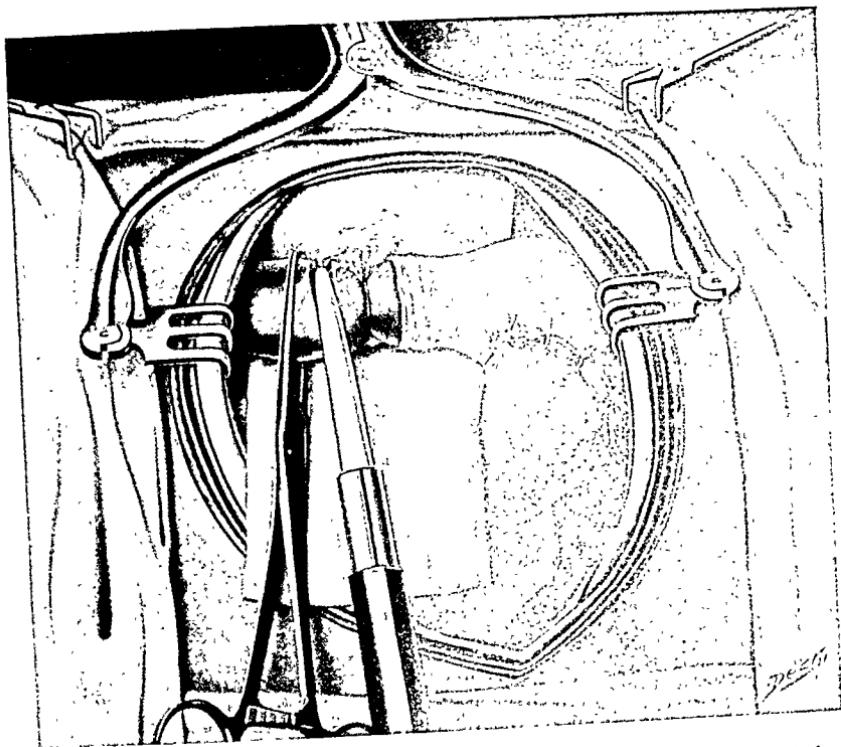
Diaphragmatic rent closed and sutures cut short, narrow tampon below œsophagus; tampon covering stomach not shown. Cuff turned back, inner coat of œsophagus tied and burnt off with Paquelin cautery, clamp closing proximal side of œsophagus.

FIG. 10.
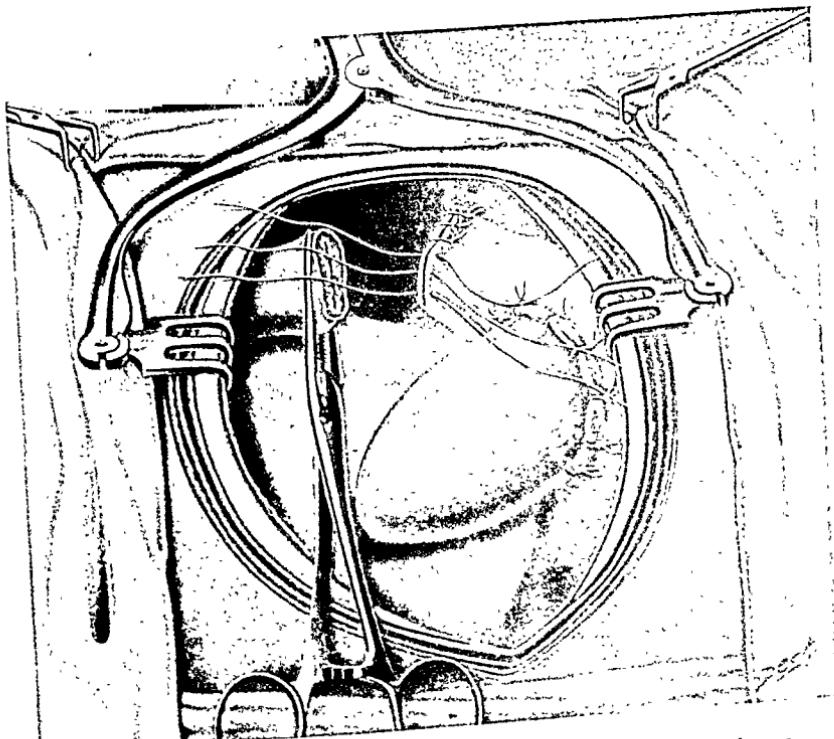
Suturing cuff; to the left, cauterized surface of proximal end of œsophagus.

FIG. 11.
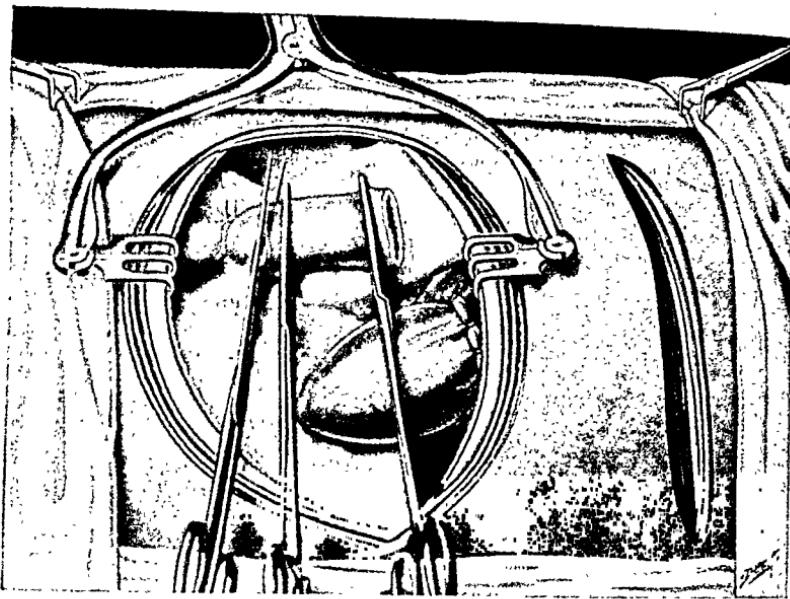
Distal œsophageal stump dropped back, covered with tampon; large curved clamp gently compresses stomach above diaphragm (not shown); second intercostal incision in fifth interspace; upper portion of œsophagus tied with rapidly absorbable catgut ligature; second clamp distally from it; scissors dividing œsophagus.

FIG. 12.
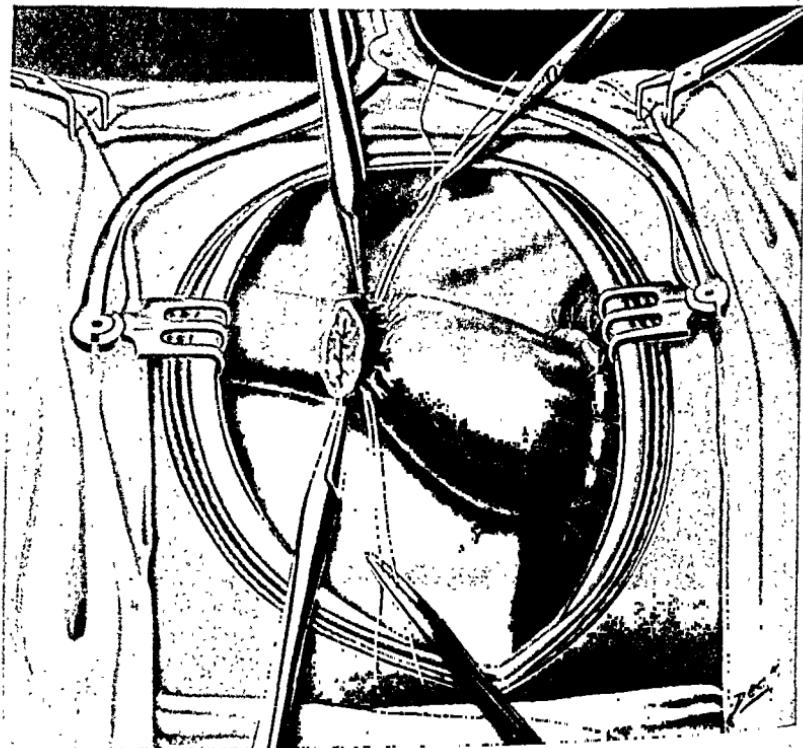
Stump of divided œsophagus drawn up by means of two forceps; wall of stomach stitched to posterior wall of œsophagus by means of silk sutures, which grasp muscularis only; the two farthest sutures, to right and left, clamped to serve as guides later on.

Fig. 13.
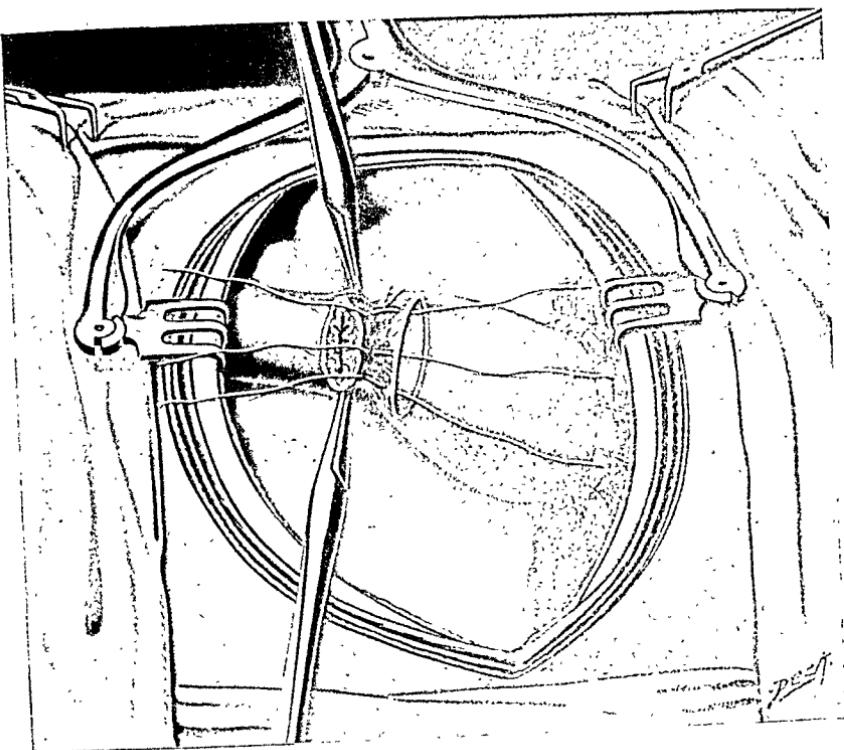
Ellipsoid-shaped excision of seromuscular coat of stomach in a horizontal direction, about three-quarters inch in front of the sutures, showing in depth mucous membrane of stomach not yet divided; the two long lateral sutures shown in Figure 12 omitted in this illustration. Upper lip of stomach wound caught with three sutures, not yet tied, uniting seromuscular coat of stomach with muscularis of œsophagus.

Fig. 14.
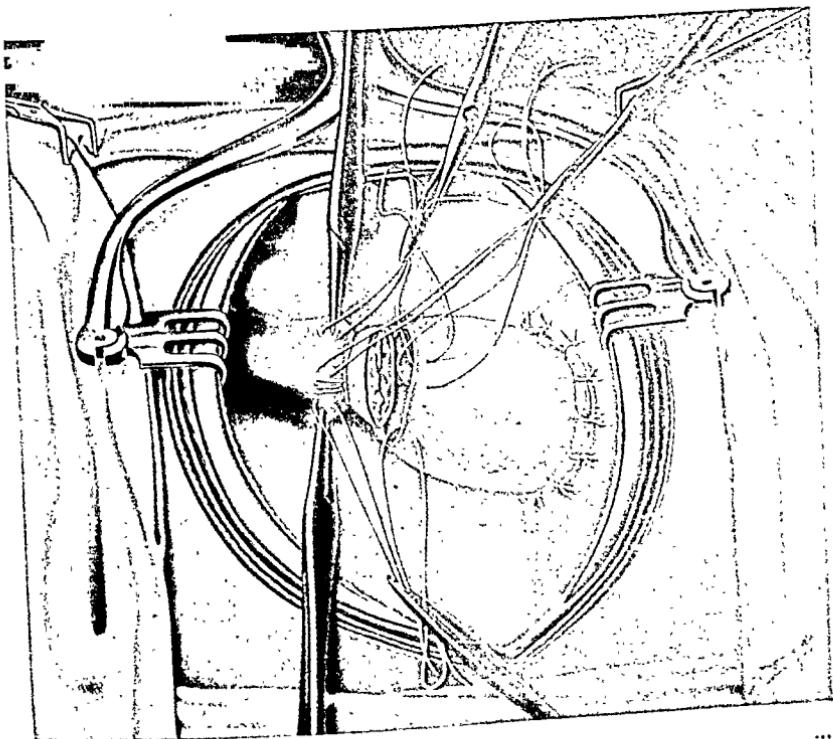
Lower lip of stomach wound and anterior wall of œsophagus caught by long silk sutures, untied, the middle portion of each suture and its two ends caught by an artery clamp.

FIG. 15.
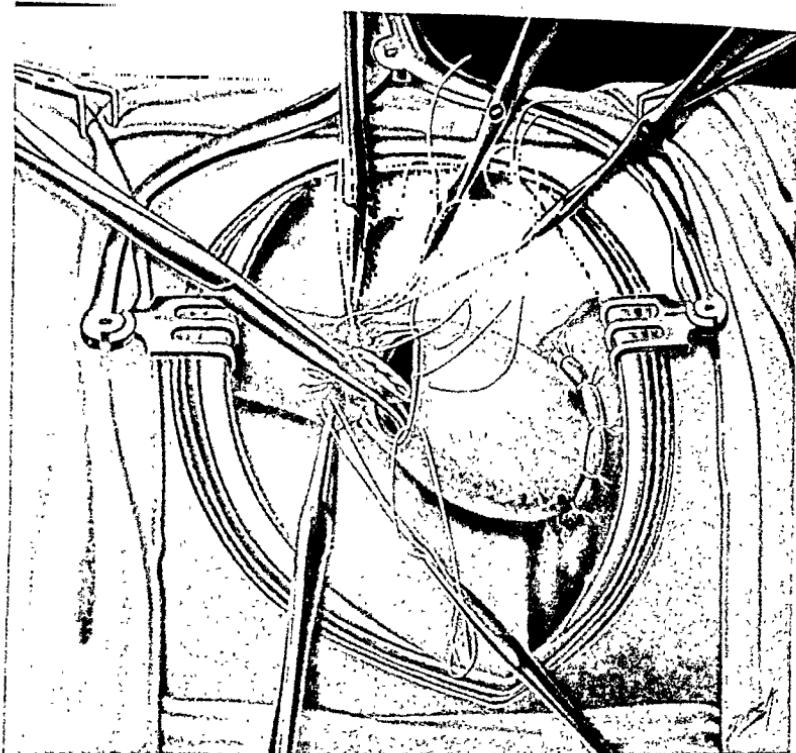
Anterior sutures separated; lower end of œsophagus caught with curved forceps for introduction into stomach.

FIG. 16.
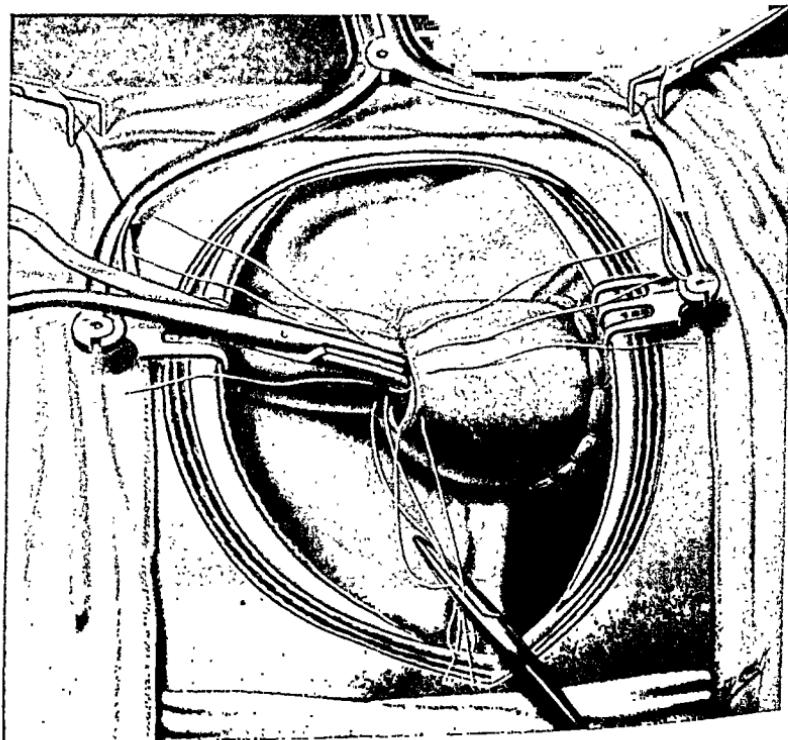
Implantation perfected, closing anterior sutures. Forceps withdrawn when tying middle suture.

FIG. 17.
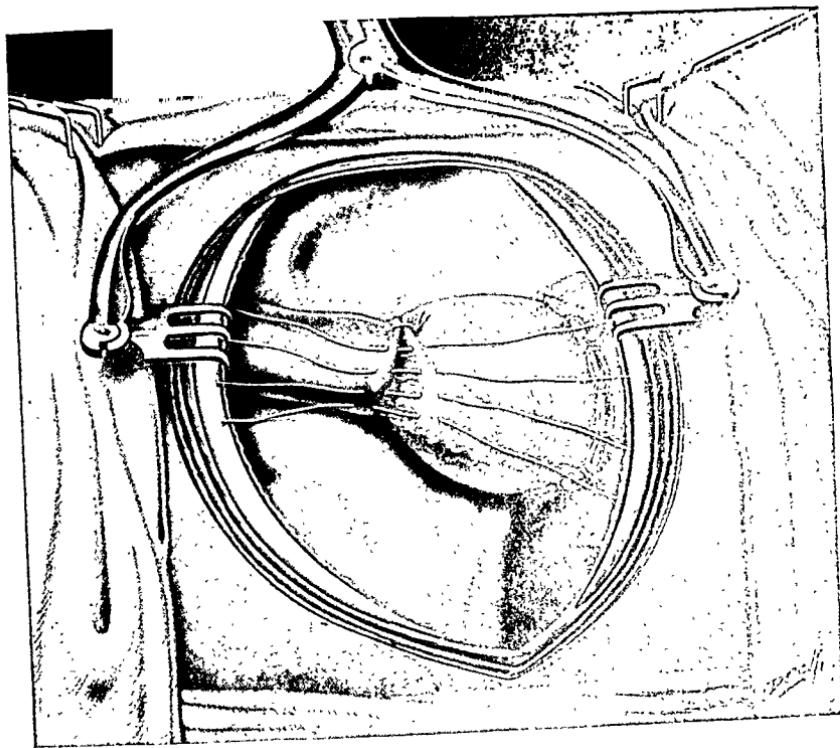
Forceps removed; first row of anterior sutures tied. Second row in progress, to cover front row by drawing a fold of the stomach up to anterior wall of œsophagus.

FIG. 18.
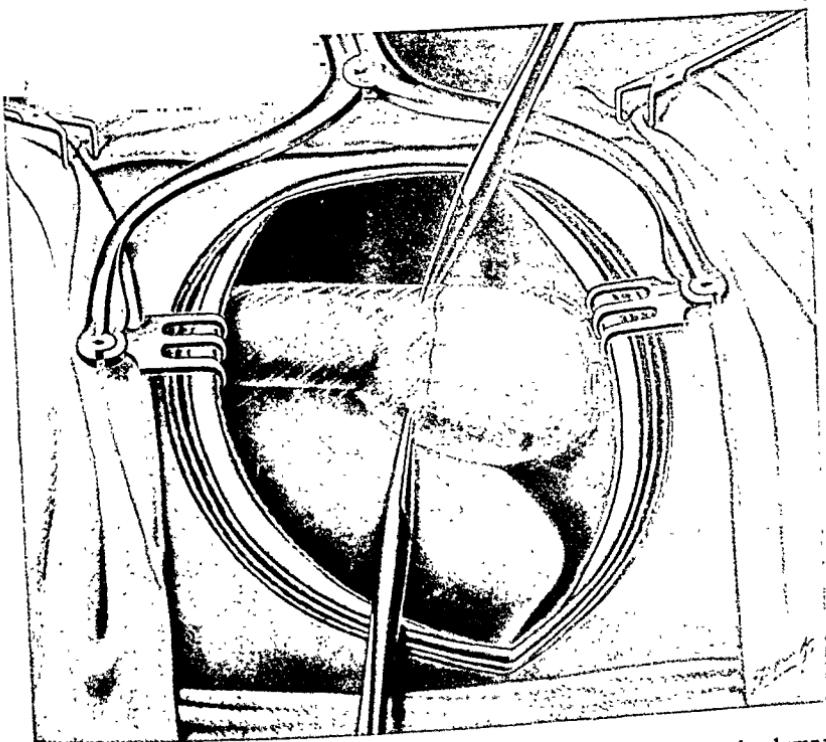
Tampons removed; œsophagus in its normal position, next to spinal column; lower border of pleura, caught with two forceps, stitched onto stomach; anastomosis, seen through pleura, within posterior mediastinum.

Fig 19
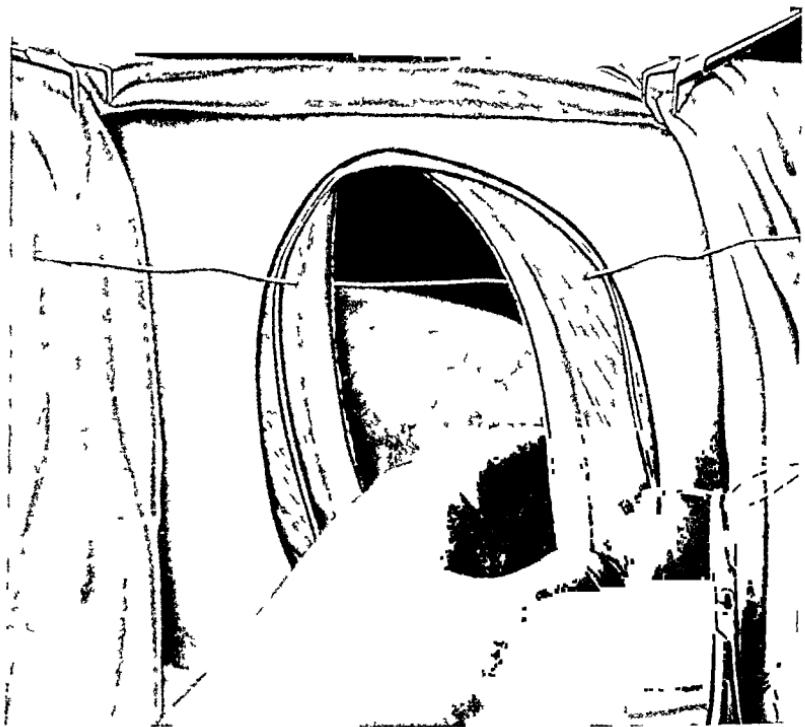
Placing pericostal silk sutures, avoiding intercostal arteries, left forefinger of surgeon raising lower intercostal space preparatory to introduction of needle at upper border of next rib below

Fig 20
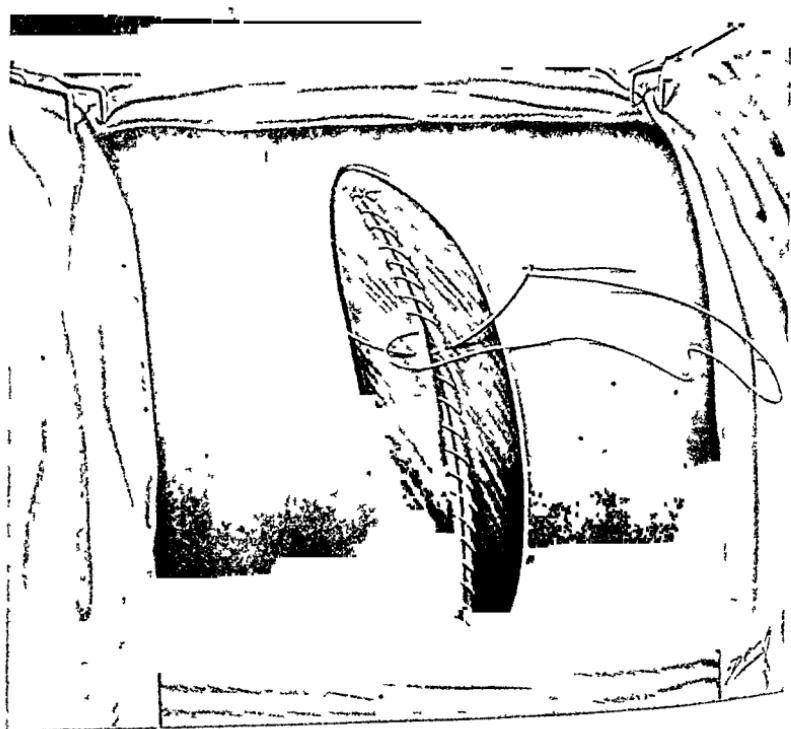
Pericostal sutures tied, first continuous catgut suture in place uniting divided muscles and fasciæ, second suture under way

Fig. 21.
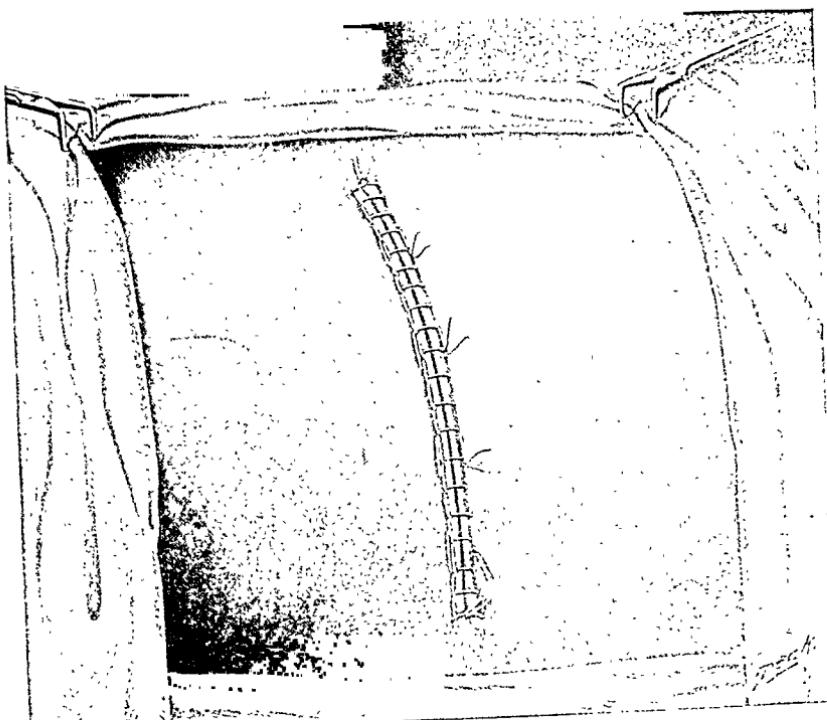
Skin wound closed with interrupted retention sutures and continuous interlocking catgut suture. Wound in eighth intercostal space, closed in the same manner, not shown.

FIG. 22.
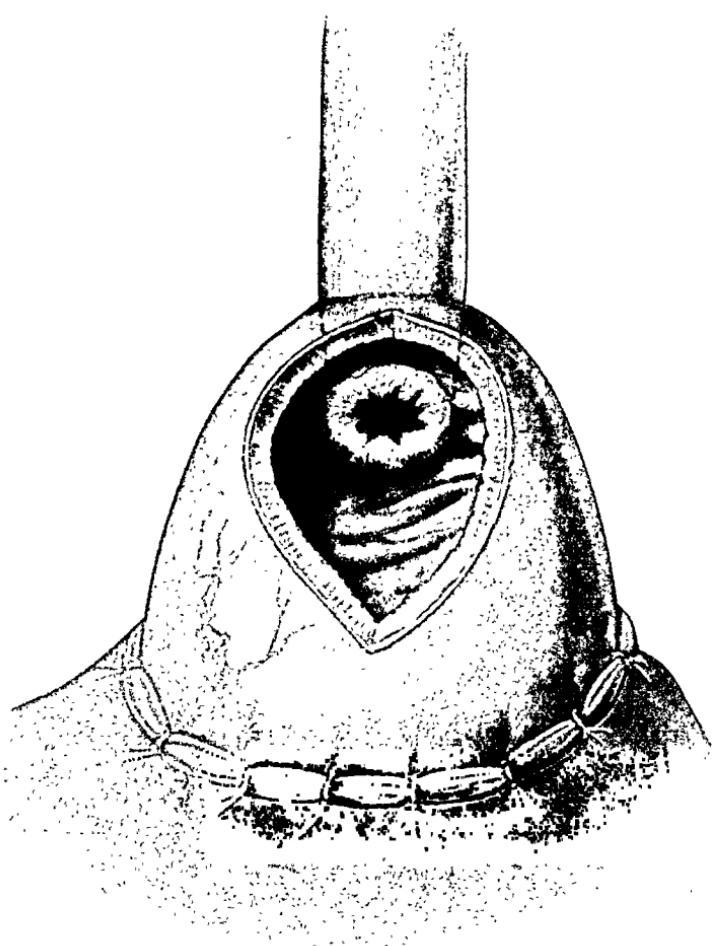
Window cut in stomach wall, to show implanted end of œsophagus. (Drawn by artist, from specimen.)

FIG. 23.
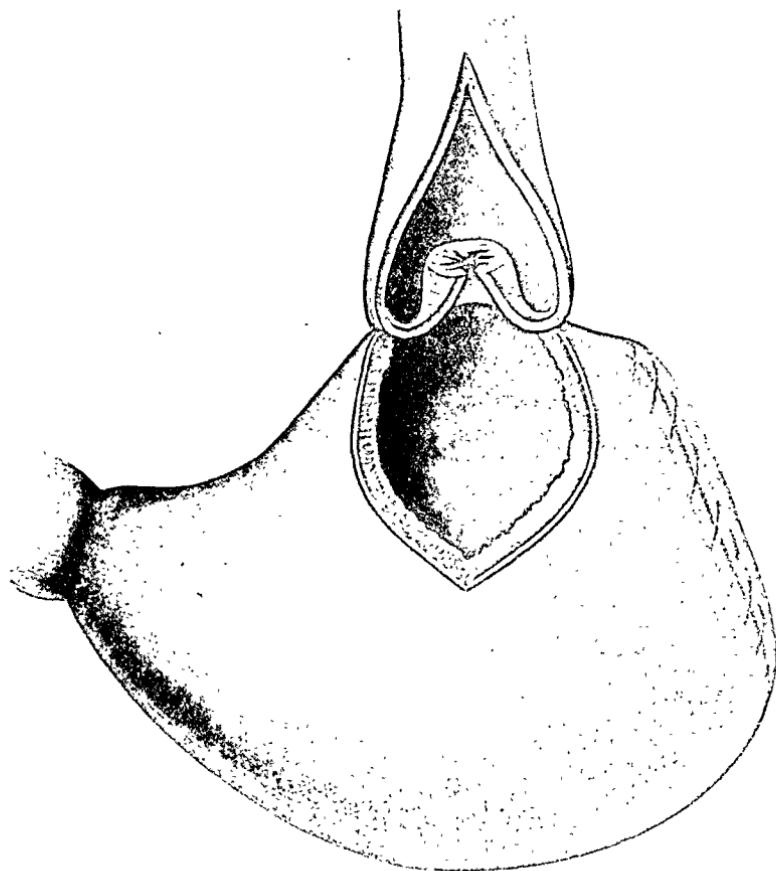
Sketch, showing implanted end of œsophagus, which had been left unnecessarily long, as found inverted back into œsophagus, closing it tightly. (Drawn by artist, from specimen.)

forefinger into the abdominal cavity, receiving with the tip of his finger the tip of the needle. By thus guiding the tip of the needle he will be sure that no other tissue comes within the grasp of the needle (Fig. 7). Each suture, after having passed through diaphragm and gastric wall, is closed at once, its ends being left long and secured by forceps. Special care must be taken to do this work thoroughly. No space should remain, through which an abdominal organ might slip. If the distance between two sutures seems too long, additional, more superficial, intermittent sutures have to be placed. Every surgeon who has worked on dogs has a number of diaphragmatic herniæ to record that were found later on and frequently were the cause of death.

8. Diaphragmatic sutures cut short; tampon placed on intrathoracic portion of stomach; with surgeon's forefinger again surrounding œsophagus, a circular incision is made with the knife down to the fascial part of the tube (Fig. 8).

9. The muscular coat is pushed back and the inner layer (fascia plus mucosa), surrounded by a silk ligature, placed as tightly as possible and the œsophagus divided between this ligature and a clamp with Paquelin's cautery (Fig. 9).

10. The muscular coat is pulled over the divided end of the œsophagus by means of silk sutures (Fig. 10). If the muscular coat appears thick, a curved needle introduced parallel with the longitudinal axis of the œsophagus may be used; of course, it must not pierce the lumen. If the muscular layer be thin, a straight needle may be pushed at right angles to the longitudinal axis from right to left anteriorly and posteriorly, thus forming a mattress suture, for closure.

11. These sutures are tied, and the stump is dropped back, and a gauze tampon placed on top. The intrathoracic part of the stomach is raised, gently milking downward, and a curved long forceps with blades protected by rubber tubing, as used for gastro-enterostomy, is placed transversely around the stomach close to the diaphragm. Second intercostal incision in fifth interspace; œsophagus ligated with rapidly absorbable catgut (Levene),* making a single knot on either side, then securing the ends with a clamp; or making an ordinary double knot on one side only, with ends cut short,† a clamp placed distally;‡ division with scissors (Fig. 11). The cut end of the œsophagus is immediately mopped with lysol solution.

12. The stump of the divided œsophagus is drawn up by means of two forceps, with narrow tip and *without* mouse-teeth, best placed before

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* This catgut has been kindly prepared for me by Dr. Th. A. Levene of the Rockefeller Institute. It is boiled for five minutes in a solution consisting of 5 per cent. soap (potassium soap preferred) and 95 per cent. alcohol.

† In order to be able to feed the dogs as soon as possible and not to be obliged to wait for the absorption of this catgut thread, it was tried in two cases to close the proximal end by means of a bow-knot and, after implantation of the cut end of the œsophagus into the stomach, remove the bow-knot by simply pulling on one of its ends before the last anterior suture was closed. The observation made in two of these cases.

dividing the tube, and a narrow compress of moist gauze placed in the depth of the wound from right to left, same as we are wont to do in performing gastro-enterostomy; the wall of the stomach is stitched to the posterior wall of the œsophagus by means of a number (5-7) of silk sutures. The two placed at the extreme end are left long and secured by forceps; the others are cut short (Fig. 12).

13. Transverse incision through seromuscular coat of stomach in horizontal direction, three-fourths inch in front of these sutures. If the stomach appears to be thick, an ellipsoid excision of the two upper gastric layers may be made. The mucous membrane of the stomach is not yet divided. The upper lip of this wound nearest the œsophagus is stitched above the first layer of sutures to the œsophagus, securing further proper adaptation of the two organs to be anastomosed. They are cut short (Fig. 13).

14. The lower lip of stomach wound exclusive of mucosa and anterior wall of œsophagus caught by five silk sutures, but not tied as yet, the middle portion and the two ends of the thread being caught by an artery clamp (Fig. 14).

15. Three of these sutures are pushed to the left and two to the right, or vice versa, in order to expose the mucous membrane of the stomach, which is now incised transversely for about three-fourths inch with scissors or knife (Fig. 15). The gastric mucosa is mopped clean with a small piece of gauze soaked in lysol.

16. Œsophageal stump introduced into stomach. The five sutures placed before are now drawn tight, the middle one being the last (Fig. 16). The latter is tied immediately after the clamp which has introduced the œsophagus has been gently withdrawn. A number of additional sutures are placed to secure the proper implantation of the œsophagus into the stomach.

17. Second row of anterior sutures bringing into apposition the serosa of the stomach and part of the œsophagus further up (Fig. 17).

18. Tampons removed and œsophagus allowed to slip back into its normal position next to spinal column. The lower border of pleura is caught with forceps, pulled over the seat of the anastomosis and stitched to the stomach, thus hiding the suture line from view and placing the anastomosis into the posterior mediastinum (Fig. 18). Care must be taken not to enclose the loop of the nervi vagi.

19. Two to three pericostal silk sutures are placed around the two adjacent ribs; they are then drawn tight and cut short (Fig. 19).

20. The soft tissues of the chest wall are closed by continuous catgut suture, layer by layer (Fig. 20).

that the œsophageal end within the stomach became inverted back into the tube, evidently in consequence of early vomiting spells and rapid agglutination of the muscularis, producing complete obstruction in this way, made me definitely abandon this otherwise simple and seemingly practical procedure. (See Fig. 23.)

‡ It is of importance to place this clamp over the ligature or just below the same at once. Observation was made repeatedly, that the air pressure from above distended the tube greatly and forced the ligature off.

21. Skin wound closed with 3 or 4 interrupted sutures, bringing the two sides in proper apposition. Continuous interlocking catgut sutures on top approximate the very edges of the skin wound.

The implantation, as it appears after completion of the operation, is illustrated by Fig. 22.

This kind of anastomosis was carried out in dogs eight times in all; after resection within the *lower third* of the œsophagus—this portion being supposed to be the seat of the disease—six times. Of this latter number three dogs died and three made an operative recovery. The causes of death were as follows:

One died within the first 12 hours after operation of secondary hemorrhage from a punctured diaphragmatic artery. One died 48 hours after operation of pneumothorax due to a tear in the lower lobe of the lung, which had been left unsutured, it having been produced by forcibly pulling the lung into the intercostal incision, when the belt of the pump slipped off the pulley and differential pressure was temporarily interrupted. (After that experiment a pump was substituted without a belt.) One died of septic pleuritic effusion with a well-functionating anastomosis, six days after operation.

Of the three that recovered of the operation, one is alive to-day, since February 23, and in excellent condition. One died on the tenth day after operation, having refused food; autopsy, probable slow necrosis of stomach. One died, also on the tenth day after operation, of distemper, this crux of surgical research work in dogs, with a well-functionating anastomosis.

To these six operations must be added two other cases in which the same kind of anastomosis was done, once in a resection of the cardia, and once in a resection of that portion of the œsophagus lying behind the aortic arch. In the case of resection of the cardia including about one-third of the cardiac end of the stomach, the dog recovered nicely from the operation, but died on the fourth day thereafter, having vomited all nourishment given. Autopsy showed the implanted lower end of the œsophagus inverted back into the tube, its muscular covering having become completely agglutinated

(Fig. 23). In this case a goodly portion of the œsophagus having been available for anastomosis, at least three-fourths of an inch of same had been implanted into the stomach. It is assumed that during one or more vomiting spells the implanted portion was pushed up into the lumen and became quickly adherent. A good lesson for the operator: First, not to allow the implanted portion to be too long; second, to introduce a bougie, if vomiting persists; third, to make use of Levene's rapidly absorbable catgut and allow the implanted portion to remain closed during the first few days after the operation, rather than to insist on making patent at once the lower cut end of the œsophagus by removing the bow-knot which closes it, before the last anterior suture is tied.

The dog in whom the part under the aortic arch had been resected, died of shock within 12 hours after operation. In this case almost the entire stomach had been pulled up into the thorax and anastomosis was then done in front of the aorta.

In addition to these eight operations which were done with the help of needle and thread I did two other cases of implantation of the divided œsophagus into the stomach on a somewhat different plan. In one an extramucous purse-string suture of silk had been placed around the implanted lower end of the divided œsophagus. This dog died on the sixth day after the operation, of distemper and gastric hemorrhage, the latter being due to a lead ball which had been attached to the cut end of the œsophagus and introduced into the stomach in order to pull it downward by its weight.

The second dog, which had made a perfect operative recovery, died suddenly on the twenty-third day after operation. At the time of this operation the method, described above, had not yet been thoroughly developed; the posterior approximating sutures, uniting the œsophageal stump to the stomach, had not been added as yet. Autopsy (Dr. F. C. Wood) showed a diaphragmatic hernia which had produced a kink in the duodenum; the stomach was filled with food. Direct mechanical pressure of the distended stomach upon the heart seemed to have been the immediate cause of death.

In view of the results obtained, the operation above de-

scribed has to be considered a proper surgical procedure, technically. As to its functional results, ways will have to be found to avoid a stricture.

The latter must be due to one of the following causes: (1) To dividing the œsophagus with Paquelin's cautery, knowing that burnt wounds have a greater tendency to contraction than cut wounds. (2) To our dividing the œsophagus perpendicularly to its longitudinal axis, which also favors the formation of a stricture. (3) To contraction of the stomach wound around the implanted œsophagus.
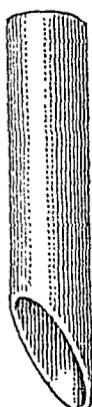
FIG. 24.   FIG. 25.
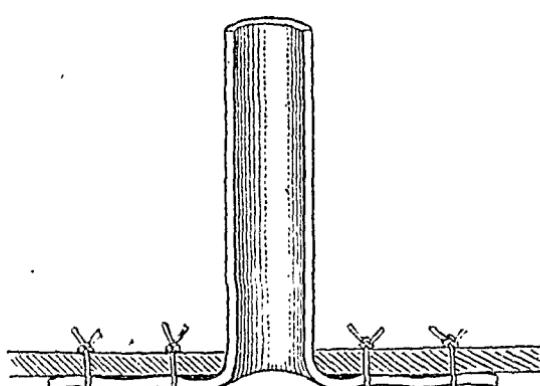
Oblique division of œsophagus, to avoid stricture.   Œsophagus divided lengthwise, mattress sutures connecting its flaps with the cauterized gastric mucosa.

To avoid possibility No. 1, scissors were in later cases used instead of Paquelin's cautery in dividing the œsophagus. To overcome the second possibility, the œsophagus might be cut obliquely instead of transversely (Fig. 24), provided sufficient material be available at the proximal end (not yet tried), or, the lower end could be divided lengthwise and either half stitched to the gastric mucosa by means of a mattress suture or sutures, after the mucosa had been cauterized with Paquelin (Fig. 25).

This latter method has been tried, but the dog died of leakage and infectious pleurisy on the fourth day after operation (faulty technic, see above).

In order to simplify the operation, a purse-string suture, avoiding the gastric mucosa, of course, might be used, as done

in the first dog operated upon with needle and thread. Post-mortem showed in that case, that the purse-string suture had slightly kinked the lower end of the œsophagus, it evidently having been drawn too tight. It is intended to try this method again and close the purse-string suture around a short cylindrical tube of magnesium, around which the lower end of the œsophagus is fastened by two circular ligatures. In this way the œsophagus cannot become strangulated by the purse-string suture and the magnesium will be absorbed. A few sutures may further secure the œsophagus to the stomach, as it is often done when using Murphy's button in abdominal surgery.

To avoid the third possibility, the gastric wall was not merely incised, but the seromuscular coat, according to thickness, either excised in an oval-shaped manner with the axis running parallel to the transverse diameter of the body, or pushed back with the handle of the knife or with Cooper's scissors and either border stitched on to the œsophagus, the gastric mucosa alone being last incised with a straight cut (see above).

We must try to render the operation less serious. Perhaps it may appear advisable in weak patients, to do a two-stage operation. For instance:

First stage: Thoracotomy in seventh or eighth intercostal space; transposition of part of stomach into thoracic cavity; loose fixation suture of stomach around rib, in order to keep the gastric wall on the stretch. Closure of thoracic wound. Jejunostomy for forced feeding. This latter operation could also be done prior to attacking the œsophagus. As the fistula is water-tight, the tube can be safely extracted for the time of operating on the thorax, the fistula can be packed with gauze and the external opening covered with zinc plaster. Leakage will not occur and infection be avoided.

Second stage, two to three weeks later, incision is made in the fifth intercostal space and œsophagogastrostomy done after resection of the growth.

We are justified in expecting this second act of the operation to be less dangerous as far as infection is concerned, than the first one. We know from our intra-abdominal work,

that serous membranes, once opened and handled, absorb less and show greater resistance to infection than at the time of the primary interference.

Sauerbruch advises the use of Murphy's button for the anastomosis. I have tried this 8 times. One of the dogs was lost in consequence of pressure necrosis of the œsophagus by the border of the button about one-half of an inch above the anastomosis. After this experience I discarded the button, reserving its use for emergency cases, and have since then worked only with needle and thread.

At the Research Laboratory of the Medical Department of Columbia University of New York a special kind of small button has been brought out for this kind of work. Perhaps this would answer better than Murphy's cholecystenterostomy button which I tried. But the fact remains that in these cases, with a portion of the stomach pulled into the thoracic cavity, the button has to wander through the *entire* gastro-intestinal tract, inclusive of pylorus, duodenum and plica duodenojejunalis. The chances of its being retained are, therefore, much greater than in cases of gastroenterostomy or lateral intestinal anastomosis. There can be no question that, if œsophagogastrostomy *can* be safely accomplished with needle and thread, this method deserves the preference.

Of course, many roads lead to Rome. Nobody can be more fully aware than myself of the fact that the procedure just described is but one method that promises success. No doubt the combined work of many surgeons along the same lines and toward the same end will soon show us the right way; and, surely, such united effort is well worth undertaking. Are not thousands of patients dying every year of œsophageal carcinoma without our being able to offer them even a ray of hope from any kind of treatment. Ways and means *must* be found that will enable us to safely attack also this type of malignant growth if seen at an early stage of its development. We *must* succeed also in the human being in properly anastomosing the proximal end of the œsophagus to the stomach, so that the patient can again eat and drink in the normal manner.

CHRONIC INTESTINAL STASIS.*

BY W. ARBUTHNOT LANE, M.S.(Lond), F.R.C.S.(Eng.),

OF LONDON,

Surgeon to Guy's Hospital; Senior Surgeon to Hospital for Sick Children,
Great Ormond Street.

CHRONIC intestinal stasis comprises the conditions arising in consequence of the progressive development of an imperfect or delayed functioning of the gastro-intestinal tract. While constipation is the most frequent objective evidence of unsatisfactory drainage associated with chronic intestinal stasis, it happens not uncommonly that there may be a daily evacuation, though in some cases the motions may be abnormally frequent and loose. Therefore, the character and frequency of the evacuations are by no means constant in this condition. I will endeavor to describe what I consider to be its pathology.

1. In the first place, there is the dilatation and extension of the cæcum into the true pelvis, associated with the development of retaining bands or mesenteries between its outer aspect and the adjacent peritoneum lining the abdominal wall. The cæcum may become so distended that after occupying the true pelvis it ascends upwards from it.

2. There is the fixation of the appendix by retaining bands continuous with those holding up the cæcum and securing the appendix usually about its centre sometimes by separate bands and at other times by a band blended with the normal mesentery of the appendix. This band is continued by the proximal portion of the appendix, and forms together with it a retaining support helping to hold up the cæcum and oppose its descent from its normal position.

The drag exerted upon the cæcum, upon the proximal part of the appendix and upon its retaining band of peritoneum, produces a kinking of the lumen of the appendix at its point of fixation, since the distal portion of this structure is neces-

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sarily tilted abruptly upon its proximal segment. The degree and chronicity of this occlusion produce varying results, all of which are grouped under the heading of "appendicitis." The point of the abdominal wall to which the appendix becomes secured varies within wide limits, but it is usually anchored to the iliac fossa. If, however, it is fixed to the posterior wall or floor of the true pelvis, the appendix in the female finds itself in a dangerous proximity to the right ovary, which is affected by any inflammatory change in the appendix, while during menstruation the engorgement of the ovary and adjacent structures accentuates any trouble in the appendix.

Though surgeons refuse to recognize the causation of these bands obstructing the appendix, they know that adhesions exist about it very constantly, and they are always very ready to avail themselves of these adhesions as an excuse for removing the appendix when they have opened the abdomen on a wrong diagnosis of disease in some other organ, such as stone in the gall-bladder, duodenal ulcer, stone in the kidney or ureter, etc. At the operation, when the incorrectness of the diagnosis is plain to all they satisfy their own conscience, the medical attendant, the patient and friends, by removing an appendix anchored in the manner I have described.

3. The ascending colon is anchored to the peritoneum lining the abdominal wall external to it by similar bands while the hepatic flexure is drawn upward and outward to an abnormally high level by the presence of bands of peritoneum of considerable density.

4. The transverse colon forms a loop whose convexity reaches, in some cases, into the pelvis, where it struggles with the cæcum for priority of occupation.

Bands of peritoneum bind the convexity of the transverse colon to the adjacent ascending and descending segments of the colon. Above, these viscera are bound directly together by newly developed adhesions, but below they are connected by an acquired mesentery.

5. The splenic flexure and descending colon present changes similar to those described on the right side.

In the large bowel, generally, the strain exerted by restraining bands may so control it as to reduce its lumen very materially at one or more points.

6. The changes in the sigmoid are perhaps the most striking and obvious. They arise in precisely the same manner as those already described. Nature makes an effort to convert the mobile loop, which would attempt to occupy the pelvis, into a narrow fixed straight tube connecting the descending colon and rectum.

This is effected by the development of little bands which pick up the outer aspect of the mesosigmoid and secure it to the adjacent peritoneum. This process continues till a proportion of the outer wall of the sigmoid itself is secured to the iliac fossa and the tube is rendered fixed and straight, all evidence of the original loop having disappeared. This ideal condition does not always exist since the bulk of the mesentery may not have been grasped securely by the newly developed adhesions before the ends of the loop have been secured and approximated by them. Consequently, a very considerable dilatation of the sigmoid results, and when it is completely obstructed it is called a volvulus.

The fixation of the sigmoid by these acquired adhesions may be irregular, and obstruction may occur at one or more points in its length.

Unfortunately for the left ovary, it lies in immediate relationship with the mesosigmoid, and it very frequently indeed becomes involved and fixed in the acquired adhesions. In some cases it appears as if the ovary is merely anchored to the contracting mesosigmoid by adhesions, while in others the ovary may be completely surrounded by and included in the altered mesosigmoid.

7. The fixation of the left ovary is very detrimental to that structure since it is followed sooner or later by a cystic change in that organ. In some cases the ovary may be infected with a chronic inflammation, or suppuration may result in it, necessitating its removal. Very rarely the sigmoid may be so much involved by the process that it may be necessary to resect a portion of it also.

The cystic ovary, completely surrounded by the adhesions, may, after a time, again become mobile in a cavity developed in them, and later may escape from it. It then ceases to have any apparent connection with the adhesions in which it was embedded except in so far as the association of an anchored sigmoid and a cystic ovary is observed to exist.

8. The ileum is very thin walled and flaccid. If its termination is drawn upward so as to expose the under surface of its mesentery the peritoneum forming its posterior surface is picked up in puckers, precisely like the mesosigmoid but not so effectually. This is clearly with the object of helping to support the loaded cæcum and oppose its displacement.

9. The stomach is dragged downward by the pull exerted upon its convexity by the depressed transverse colon, while the pylorus and first portion of the duodenum are bound to the under surface of the liver and often to the cystic duct and gall-bladder. The stomach is dilated, apparently because of the kink effected at the exit by the downward drag on the convexity of the stomach and the resistance offered by the adhesions binding the pylorus and duodenum to the liver.

Owing to the very different construction and mechanics of the abdomen and of the viscera in the sexes, the mode of anchoring of the pylorus and duodenum differs somewhat. I believe that this variation is responsible for the greater frequency of duodenal ulcer in the male and of gastric ulcer in the female.

The posterior surface of the stomach is not infrequently adherent to the peritoneum covering the pancreas, etc.

10. The gall-bladder is generally full of bile, and gall-stones are not infrequently present. The development of gall-stones may be consequent on the stagnation of bile in the gall-bladder whose evacuation is impaired by the drag upon it or its duct by the anchored duodenum and pylorus and by the prolapse of the liver itself. Women being much more frequently affected by intestinal stasis than men, suffer more often from gall-stones. It is a noteworthy fact, that while

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gall-stones do not form in cases of intestinal stasis in which loss of flesh results at an early period of life from toxic absorption, they do so very readily in stout women, in whom intestinal stasis develops in a marked degree comparatively late in life.

11. The breasts show changes which vary from a recurring mastitis affecting the upper and outer segments of the breasts, and especially of the left, to a definite cystic degeneration involving the whole of both breasts. These degenerated breasts are very susceptible to the development of malignant disease.

12. The kidneys are mobile.

13. There is very little fat.

14. The skin is stained and inelastic.

15. Respiration is chiefly diaphragmatic.

16. The circulation is bad, as evidenced by the coldness of the extremities.

17. The muscles are very friable and small in bulk.

Symptoms.—The symptoms produced by this condition of things are due in part to the interference in the normal functioning, and are expressed by pain, and in part to the absorption of poisonous material, and are evidenced as toxæmia.

While toxic symptoms may exist without pain, pain has always associated with it definite evidence of auto-intoxication. I would just mention that many of the objective evidences of auto-intoxication, such as pigmentation of the skin and bad smelling perspiration. are much influenced by the color of the hair. In light-haired people a very advanced condition of poisoning may exist without the presence of these symptoms, while in dark-haired people these evidences appear at an early period.

Pain is due apparently to the distention of a portion of the bowel with fecal contents and their gaseous products. or by the passage of fecal material through the bowel. For instance, the distention of the cæcum is a frequent and distressing symptom.

Pain about the hepatic and splenic flexures, both in front

and behind, results from the obstruction which exists at those points and from the drag or strain upon the retaining bands by the loaded bowel in the erect posture of the trunk.

Pain in the sigmoid segment may be due to the difficulty in forcing the contents through a fixed straight tube of diminished calibre, length, and elasticity, whose mucous membrane may be gorged, inflamed or even ulcerated, or to the distention of a loop or loops placed at a mechanical disadvantage by irregular anchoring by adhesions. Pain also results from the distention of the stomach, and also of the small bowel because of its delayed functioning.

Pain in the fixed left ovary is frequently a distressing symptom, especially at the periods. The fixation of this irritated organ renders it very tender on pressure, especially if examined bimanually, since it cannot readily avoid the pressure of the fingers as a mobile ovary does. Apart from this, there are the mechanical symptoms which ensue from the progressive development of the cystic condition of the ovary which is now found to be more frequently malignant in structure than was supposed.

Degenerative cystic changes in the breast are very commonly present in a varying degree in certain cases of chronic intestinal stasis. This change is usually first observed in the upper and outer segment of the left breast, and later in the corresponding area of the right breast.

In the young unmarried woman a chronic mastitis which is accentuated at the periods is a very common symptom. It affects the same areas of the breasts as does the cystic change which appears later. In a number of patients on whom I have operated for chronic intestinal stasis, one or both breasts had been removed for cystic degeneration. This condition has been called Schimmelbusch's disease. I have been much struck by the fact that these degenerative conditions do not arise in the breasts of women having regular intercourse, however toxic they may be, while they develop very rapidly on its cessation. How far the mechanical impairment of the sexual apparatus here referred to is responsible for the loss

of sexual appetite, which is a very marked feature in these women, and how far it is consequent on the associated tox-æmia, is a matter of question. In any case it is much influenced for good by the cessation of the auto-intoxication following on some satisfactory treatment of the defective intestinal drainage. It is not improbable that the more frequent presence of cystic change in the left breast results from the fact that the left ovary is damaged and rendered cystic very much more often than the right, owing to its fixation by or inclusion in the bands which obliterate the mesosigmoid and shorten and straighten the sigmoid.

The pain due to movable kidneys, gall-stones, gastric and duodenal ulcers, pancreatitis, renal conditions due to the narrowing of the right ureter by the band retaining the appendix or by suppuration about the appendix, uterine versions and flexions, and to many other conditions which I believe are all effects of chronic intestinal stasis, is fairly characteristic. It is difficult to separate abruptly the symptoms that are brought about mechanically by intestinal stasis from those which result from the consequent auto-intoxication, since many are due to both.

Here I would like to call attention particularly to the work of Dr. Victor Vaughan and Miss Wheeler "On the Effects of Egg White and Its Split Products on Animals," and the work of Dr. Turck "On Experimental Studies on Round Ulcer of the Stomach and Duodenum." I can do no more than refer to them here, but their importance in reference to intestinal stasis is obviously very great indeed.

The chief toxic symptoms are: Headache, a feeling of mental and physical lassitude, an inability to perform the ordinary duties of life, mental misery and distress, nerve symptoms (as migraine, etc.), which are comprised usually under the term of biliousness, and a want of control over the temper which renders these patients unpleasant and unhappy companions.

The symptoms for which the patient seeks relief from the surgeon vary materially with the position and occupation

of the sufferer. While the unfortunate governess or domestic servant will struggle on until complete physical disability renders her incapable of performing her duties, the woman who has not to earn her living calls attention rather to the mental distress from which she suffers. For this reason the patient in good circumstances receives attention at a much earlier stage in the disease than does the poor worker and either requires a less extensive operation or benefits much more from a serious one. Too frequently the poorer patient has reached a stage in which operative procedures, however extensive, afford only a temporary benefit, since the distention of the small intestine having reached a certain limit is liable to return and progress after an interval, and with this distention is associated pain for which very little relief can be afforded.

Of the many cases of chronic intestinal stasis in private practice which called for operative interference, in nine only have I removed the large bowel. Of these one died, and that accidentally from the bursting of a small deep-seated stitch abscess into the general cavity. Of the larger number of private cases in which division of the ileum and its junction with the large bowel was effected, there was no death from the operation. One of these patients died from acute obstruction six months after the operation. The cases in private practice in which simple division of constricting bands or the establishment of a junction between the occluded ileum and the sigmoid or rectum are sufficient, are much more commonly met with than in hospital practice.

Auto-intoxication reduces the resisting power of the individual to the entry of organisms of various sorts, and facilitates their obtaining a foothold in some of the tissues of the body. I will call attention to only one organism—namely, the tubercle bacillus, since it illustrates very well this depreciation in the vitality of the tissues. The examination of a large number of dark-haired children affected with chronic tubercular disease of joints will show the presence in them of unmistakable signs of auto-intoxication.

The examination of a number of girls suffering from
lateral curvature or the fixation of the asymmetrical position
of rest will afford striking evidence of the effect of the toxin
in depreciating the respiratory capacity and energy of the
individual, and will show them to be characteristically toxic.
In them, as in the tubercular cases alluded to, thoracic respira-
tion is more or less completely in abeyance.

TREATMENT.

If I have done no more than to impress on the reader the
importance of regarding chronic intestinal stasis as a very
serious condition, and one whose capacity for harm is great
and far-reaching in its results, I shall feel that my efforts
have not been without result. We must acquire as thorough a
knowledge as possible of the causation and pathology of
delayed intestinal drainage, and so endeavor to render our
treatment of its several stages as scientific as possible.

I do not propose to discuss the medical treatment here,
but will assume that the condition has developed to a degree
that such treatment is obviously inefficacious to give the relief
required. In other words, a stage has been reached in which,
owing to the delay in evacuating its contents, the large bowel
has not only ceased to perform a useful function but has
become such a source of danger that its removal from the
drainage scheme will be of great service to the body.

It depends on the development of the condition as to
whether it is sufficient to separate and destroy constricting
bands, or to divide the ileum and to connect it with the sigmoid
or rectum, or whether it is necessary to remove the large
bowel proximal to the junction. While in an early stage, and
especially in the male subject, the obstruction at the hepatic
or splenic flexures or at the sigmoid may be relieved by the
division of bands producing constriction, in a late stage when
the small intestine has undergone extreme changes the removal
of the whole of the large bowel proximal to a junction between
the small intestine and the sigmoid affords only a temporary
alleviation of symptoms.

The most favorable cases for operation are those in which the symptoms are of a toxic rather than of a painful nature. In such, the division of the ileum and its junction with the lower part of the large bowel gives complete relief to the symptoms, and the consequent physical and mental improvement is extraordinary. When painful symptoms are much in evidence the large bowel should be removed. The risk entailed by operation can be reduced very materially by first relieving the toxic symptoms by connecting the divided ileum with the sigmoid or rectum, and later, when the general condition of the patient has improved in consequence of this procedure, the large bowel can be excised if the symptoms demand it. I do not pretend that removal of the large bowel is not a very serious operation in certain circumstances. Indeed, in many of these patients any serious operation must be regarded as being dangerous to life, the danger varying chiefly with the degree of toxicity. I may say that in these and similar cases the risk can be very greatly diminished by the subcutaneous injection of a large quantity of normal saline solution immediately before the operation. By this means the patient appears to suffer a minimum of shock from the extensive operative procedure, and vomiting either does not follow it or, should it do so, is trivial in character. In these cases the absence of vomiting is a matter of very great importance. It was very frequent and severe after my earlier excisions of the large intestine, and was the cause of more than one fatal result. Besides the distress and depressing influence it exerted on the patient, the constantly recurring strain on a long wound was very liable to render it insecure or to determine the development of a septic infection in it which would probably not have occurred had the recently incised structures been kept at rest. The risk of an infection starting in the peritoneal cavity appears to be very small. The mode in which the subcutaneous transfusion of normal saline employed immediately before the operation acts, has been very clearly demonstrated by Dr. Crile's most interesting and valuable researches on the production of shock, of which America must be very justly proud.

SURGERY OF THE LARGE INTESTINE.*

BY WILLIAM J. MAYO, M.D.,

OF ROCHESTER, MINNESOTA,

Surgeon to St. Mary's Hospital.

I. GENERAL CONSIDERATIONS.

FROM the foregut we get the stomach and duodenum to a point below the common duct, the liver and the pancreas. All of these organs derive their nourishment from the cœliac axis and are concerned in the preparation of food for absorption but do not themselves absorb. Morphologically the small intestine begins at the pylorus, functionally at a point beyond the common duct.

The derivatives of the midgut are concerned in absorption and assimilation, and extend from the middle of the duodenum to the splenic flexure of the colon, where the hindgut begins and corresponds to the area of distribution of the superior mesenteric artery.

Ninety per cent. of the solids are picked up in the jejunum and ileum, and about half of the fluids are absorbed there. Ten per cent. of the solids and the balance of the fluids are absorbed in the large intestine proximal to the splenic flexure, largely in the cæcum. A physiological contraction between the cæcum and ascending colon at the situation of the cæcocolic sphincter in certain lower animals, holds the material between this point and the ileocæcal valves during absorption, and accounts for the localized cæcal distention with gas and fluids noticeable on palpation in diarrhœal disturbances. The fluids ingested, and also those secreted by the liver and pancreas, are used to keep the ingesta thin and in close contact with the valvulæ conniventes and to mechanically float the residue finally into the cæcum, where fluidity is no longer necessary

and where it is re-absorbed. The chemical change from alkalinity to acidity of the material upon entering the large intestine, a change which is connected with bacterial action, causes the formation of gases which play an important part in the further progress of the residue in the large intestine.

The differentiation between the midgut and the hindgut is not so well marked as between the foregut and the midgut (Young-Robinson). The hindgut gives rise to the descending colon, the sigmoid and rectum to the anal canal, and is supplied by the inferior mesenteric artery. Excepting during defecation the normal intestinal movement in this portion of the intestinal tract is antiperistaltic, so that fluids introduced into the rectum, as in Murphy's proctoclysis, are carried backward for absorption above the splenic flexure, only a small amount being taken up by the derivatives of the hindgut, although many drugs and chemicals may be absorbed here. Bond has shown that solid particles when placed in the rectum are also carried upward by what he calls "reverse mucous currents." The descending colon, which marks the beginning of the hindgut, is usually found empty and acts as a passageway between the physiologically active midgut and the passive sigmoid. The function of the latter is to act as a fecal container, which its trap-like curves enable it to do.

At the juncture of the fundus and the antrum of the stomach there is a physiological muscular activity which takes the place of the antral sphincter in certain of the lower animals. From this point to the descending colon the control depends upon internal secretions, and the sympathetic ganglia, and, while influenced by Auerbach's and Meissner's plexuses, this control is largely independent of the cerebrospinal nervous system, as the maintenance of the body is a primitive function and existed before the development of the cerebrospinal system.

In the eleventh week of fetal existence the large intestine shows the cæcal bud beginning to contract at its extremity, the site of the future appendix. The intestinal tube, which has been straight, has developed the U-shaped loop connected with

the yolk-sac by the vitelline duct close to its middle. The remains of this duct may give rise to a Meckel's diverticulum which, if present, is usually to be found in the lower ileum within two or three feet of the ileocæcal valve. At the third month the entire large intestine is still to the left of the median line; but by the fourth month the head of the colon has rotated across the superior mesenteric artery and duodenum, and lies underneath the liver, to reach its normal situation soon after birth. During this rotation the contraction of the large herbivorous-like cæcum into the carnivorous type is rapid, and the appendix is one result. Failure of complete rotation of the large intestine accounts for those cases of appendicitis on the left side or under the liver.

According to Ribbert, at birth the appendix is one-tenth the length of the large intestine, and in the adult, one-twentieth. Birmingham gives the length as one-sixteenth at birth and one-twentieth in the adult. Up to six years of age the normal appendix always contains a lumen, but after this time there often begins an involution with obliteration of the lumen from the tip toward the base. Ribbert states that in adults thirty-five years of age 25 per cent. of appendices are completely obliterated, and at seventy years of age one-half or more are obliterated. Birmingham's investigations do not bear out Ribbert's claims. He states that only 3 to 4 per cent. of adults have completely obliterated appendices, but that 25 per cent. of young adults and 50 per cent. at the age of fifty show partial obliteration. Our observations agree with those made by Birmingham.

Irregular obliteration, producing dams and strictures along the lumen of the appendix, is undoubtedly an important factor in the sedimentation which produces those fecal concretions which play so important a rôle in the causation of appendicitis.

Berry believes that the appendix is an important organ containing lymphoid structures like Peyer's patches, and that the tendency to obliteration seen in adults is the normal atrophy of lymph organs which occurs after the growing period of the individual has been accomplished.

Macewen and Keetley deprecate the present tendency to remove the appendix unless absolutely necessary to save life, believing that its removal tends to cause constipation and other colonic diseases. Keetley goes so far as to advocate the practice of opening up the appendix, removing stones if they are present, evacuating abscesses and finally burying the remnant of the organ in the abdominal wall to prevent future chance of peritonitis, thinking thus not only to maintain the function of the appendix but to enable its later use for appendicostomy should colonic inflammation or obstinate constipation supervene. I am unable to concur in this opinion as I cannot believe that an organ of such exceptional value as they state the appendix to be would so early become atrophied were it endowed with so great a function. At best, the saving of a functionally useless organ which is so diseased as to contain abscesses, stones, etc., is not in harmony with modern views. We are only just beginning to recognize that serious functional digestive disturbances, such as pyloric spasm (appendiceal dyspepsia), colitis, etc., are often produced by a chronically diseased appendix.

It is evident that constipation most directly concerns the sigmoid and that its function as a fecal container is a comparatively late evolution. This is shown by the great variations in its length, size and shape (Finney). The fact that the sigmoid, like the fundus of the stomach, is more or less under conscious control of the cerebrospinal nervous system, also indicates a late development.

In the ANNALS OF SURGERY, December, 1900, the writer calls attention to certain varieties of constipation having primary origin in the small intestine due to congenital or acquired narrowing at the ileocæcal orifice, and reported several cases relieved by operation. Further experience has strengthened the opinion therein expressed. An obstinate constipation may depend upon too prolonged retention of the ingesta in the small intestine, interfering with proper chemical changes.

The head of the colon is extensively sacculated and of large capacity, but gradually diminishes in size, and in the descend-

ing colon and sigmoid the sacculations are primitive (Fig. 1). The diameter of the sigmoid is less than one-half that of the cæcum. The longitudinal bands of muscle have, however, gradually increased in width and strength until at the juncture of the sigmoid and rectum they practically surround the intestine and a complete investment extends down about the rectum, showing the increased muscular pressure which is necessary to propel non-liquid contents. Defecation is accomplished largely by siphonage which usually completely empties the sigmoid. A hardened mass of fæces forms the apex of the stool-mass which is set in motion by the abdominal muscles compressing the intestinal gases. The normal rectum in the quiescent state contains fæces only temporarily, as is shown by the examination of a large number of males for the army service. In the female, and sometimes in the male, an acquired tolerance may be found, and the rectum to contain chronically more or less hardened fæces.

Treves in 1885 and Jonnesco in 1889 called attention to the inaccuracy of the anatomical description of the lowest sigmoid and first portion of the rectum, showing correctly, as I believe, that the so-called " first portion of the rectum" should be considered the terminal portion of the sigmoid down to the ending of the mesenteric attachment at about the third sacral vertebra. Here the rectum begins and extends to the anal canal which lies below the levator-ani muscle. Embryologically, the true rectum has its origin from the highly differentiated lower part of the hindgut called the *cloaca*, which forms the bladder and rectum. This primitive association is of importance in the study of malignant disease.

Symington has made careful studies of the lower rectum and points out that the anal canal, about one to one and one-fourth inches in length, is completely invested with muscle and has its origin in the proctodeum, and for this reason in cancer of this locality the inguinal glands are liable to be involved as well as the perirectal.

British anatomists divide the sigmoid into two portions. First, the iliac, 5 to 6 inches in length, extending from the

Fig. 1.
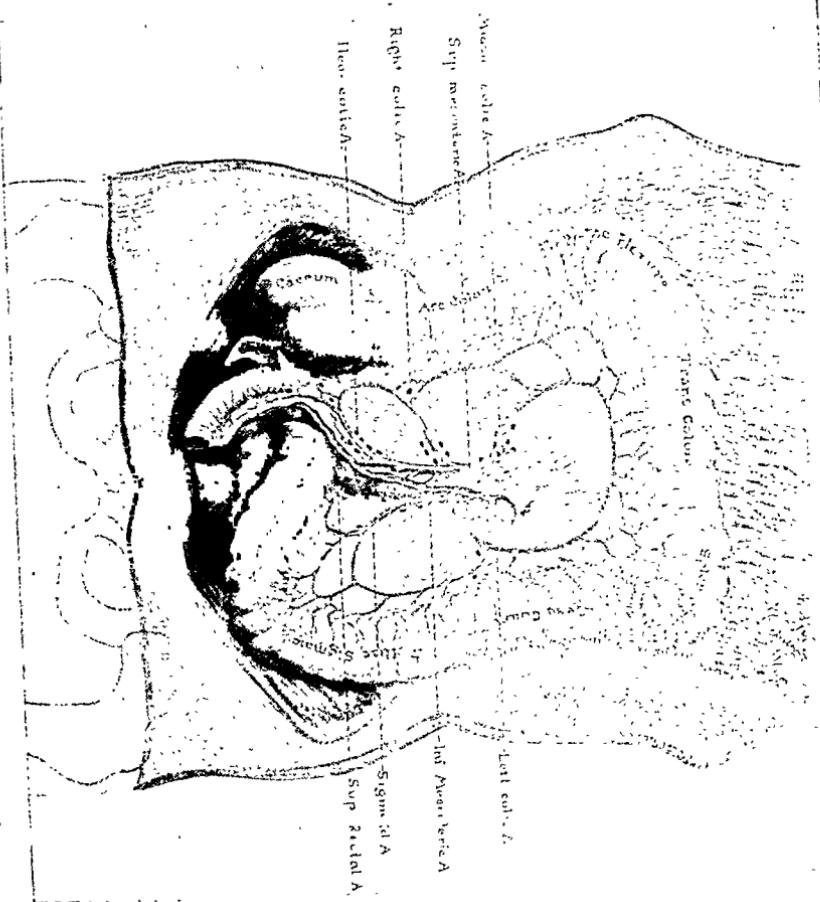
Anatomy of the large intestine. Note the relation of glands and blood-vessels.

Fig. 2

Mobilization of cæcum and ascending colon. Note duodenum and ureter exposed.

descending colon to brim of the true pelvis and having, if any, a very limited mesentery. Second, the pelvic portion, which averages 16 to 18 inches in length, has a long mesentery and loops across the median line. Cunningham states that in 92 per cent. of subjects the pelvic sigmoid lies in the true pelvis after death. There is no question but that this description is more accurate and is based on a better understanding of the anatomy than that which is ordinarily accepted in this country (Fig. 1).

The large intestine is from 5 to 5½ feet in length, and is about one-fifth of the intestinal tract.

The cæcum and appendix are ordinarily completely invested by peritoneum. The transverse colon, which, including the hepatic and splenic flexure, is about 20 inches in length, and the pelvic sigmoid, have a well developed mesentery. The ascending and descending colon, and the iliac sigmoid are more or less closely attached to the posteriolateral parietes.

The ascending colon, averaging from 7 to 8 inches in length, has an insecure attachment to the posterior muscles in its retroperitoneal extent, and upon this the weight of the ileocæcal coil is suspended. The result of the traction tends to loosen the ascending colon from its bed, leaving a pouch into which the right kidney often prolapses, the descent of the kidney being aided by the attachment of the colon to Garroto's capsule and the so-called " nephrocolic ligament." On the left side this does not obtain, as the descending colon and the iliac sigmoid is closely attached in its retroperitoneal extent and gives a weight-bearing space of from 12 to 14 inches.

Under normal conditions, as shown by Monks, the lowest ileum lies in the pelvis, the last 8 inches ascending from the pelvis to the cæcum, and its terminal 2 inches is closely attached on the cæcal side (Fig. 4). This attachment takes place early in fetal existence so that, as a rule, the base of the appendix will be found within three-fourths of an inch of the ileocæcal orifice. The lop-sided appearance of the cæcum is due to the development of sacculations, which more easily occur on the free side. The terminal 6 inches of the ileum has the same

blood supply and lymph drainage as the cæcum, through the ileocæcal vessels. For this reason, in all cases of malignant diseases of the cæcum, the appendix and terminal 6 inches of the ileum must be removed. Occasionally a lymph gland will lie in the meso-appendix, and if so, lymph drainage from the right ovary and tube may find its way into it through Cleido's ligament.

The ascending colon is supplied by the right colic artery, a branch of the superior mesenteric, anastomosing below with the ileocolic and above with the branches of the middle colic. The lymphatic drainage extends into the lymphatic glands at the base of the right colic artery and also in the ileocolic group. In carcinoma of the ascending colon it is necessary to remove the cæcum and the terminal 6 inches of the ileum in order to secure the tributary lymph nodes.

The middle colic artery comes from the superior mesenteric just below the pancreas, passing almost directly downward into the transverse mesocolon where it gives off large arterial arches to the right and left. The main arch passes to the left to anastomose with the left colic which arises from the inferior mesenteric. The middle colic is the main source of the blood supply of the transverse colon, including the hepatic and splenic flexures, and while the anastomoses with the right and left colic suffice for the hepatic and splenic flexures respectively, Krönlein points out that in four cases out of five the transverse colon itself will not be nourished in its whole extent if the middle colic vessels are ligated. Injury to this vessel sometimes happens in resection of the stomach for cancer and may cause gangrene of the transverse colon.

The splenic flexure of the colon has a reduplication of the peritoneum derived embryologically from the omentum, which is sufficiently defined to be called the " costocolic ligament." The costocolic ligament has no large blood vessels, and by division of it the splenic flexure is, loosened from its deep situation and can be readily brought to the surface. The hepatic flexure has not this source of retention, therefore it is easily accessible, although there is often an extension to it of the duodenohepatic ligament.

The lymph drainage of the hepatic and splenic flexures as well as the transverse colon follows into the root of the transverse mesocolon. The lymph nodes are in close communication with the deep lymph-chain along the aorta and about the head of the pancreas, and in malignant disease the accurate removal of the lymphatic-bearing mesentery is correspondingly difficult.

The left colic artery supplies the descending colon, but its anastomosis with the middle colic above and the sigmoid below makes extensive resections in this vicinity relatively safe. Fortunately the lymph supply diminishes rapidly from the ileocæcal coil, and has reached its lowest ebb in the sigmoid. The very nature of the function of the colon, containing as it does virulent bacteria and toxic poisons, makes this lymph sparseness a necessity. Butlin has shown that over 60 per cent. of the deaths from cancer of the colon take place from obstruction or other causes before there is general metastasis, and many times, if enlarged glands are present, they will be found inflammatory.

The tendency of the lymph drainage of the descending colon is towards the transverse mesocolon following the middle colic tributaries.

The sigmoid derives its blood supply from the sigmoid artery, a branch of the inferior mesenteric, and anastomoses freely above with the left colic, and below with the superior rectal. The lymph drainage follows the vessels, and Moynihan points out that the highest lymph node lies at the origin of the inferior mesenteric vessel. It would appear necessary, therefore, in operating for carcinoma of the sigmoid to resect extensively so as to remove the Moynihan gland with the mesentery, although this may necessitate destruction of the inferior mesenteric vessel with its tributary intestine.

The terminal portion of the sigmoid, the so-called "first portion of the rectum," is supplied by the superior rectal artery which communicates freely with the middle hæmorrhoidal arteries. The lymph drainage follows the superior rectal vessel which is the direct continuation of the inferior mesenteric, and

to secure the highest lymph node at the origin of the inferior mesenteric, it may become necessary to ligate this vessel and remove the devitalized colon possibly almost to the splenic flexure.

In estimating the feasibility of removing malignant disease of the large intestine, the examination of the liver for embolic carcinoma should not be forgotten. In our experience, hepatic secondaries have been a larger cause of contra-indication to radical operation in mechanically removable tumors than inoperable glandular metastasis.

By rectal touch the peritoneal sac can be felt anteriorly at the rectovesical fold. Carcinoma of any viscus in the peritoneal cavity may permit detachment of carcinoma cells which gravitate into the cul-de-sac and graft upon the adjacent sigmoid, giving rise to the characteristic nodules which indicate the nature of the primary and possibly unlocated disease.

There are a number of fossæ in connection with the large intestine which may occasionally have surgical importance. They are due to faulty blending of the peritoneum with the large intestine, giving rise to small pockets extending up behind the bowel. There are several of these recesses about the cæcum in which the appendix is occasionally found.

This faulty blending of the large intestine with the peritoneum is well shown on the right side, the peritoneal sac being well developed before the cæcum and ascending colon reaches its normal position, which does not occur until at or near birth. The result is that the attachment of the head of the colon to the parietal peritoneum is of a veil-like nature, resembling adhesions.

The entire large intestine is covered with a greater or less number of appendices epiploicæ, and in the obese these epiploic tags may reach considerable size. As a result of injury or local peritonitis they sometimes become attached to the parietes or neighboring structures, causing fixation of the intestine, or a band may be the cause of obstruction. Torsion may occur, with necrosis. We have met with two examples of this condition.

II.—SURGICAL CONSIDERATIONS.

Preparation.—Perhaps no factor has proved of greater importance to the human race than the sterilization of food by cooking. While the secretions of the stomach itself outside of the stomach do not have marked bactericidal properties, it should not be forgotten that bacteria are vegetable organisms, and that the digestive power of the stomach acts to destroy the bulk of the micro-organisms introduced so that the contents of the duodenum and upper jejunum, as shown by Adami and Cushing, are relatively sterile. This is shown clinically by the higher percentage of recoveries from perforations, gunshot injuries, etc., in the stomach, duodenum and jejunum, as contrasted with the ileum and colon.

The ileum contains a rapidly increasing number of bacteria and the lower two feet teem with virulent organisms. In the colon bacterial growth is marked and adds materially to the bulk of the stool. Hochenegg points out that liquid stool contains very active bacteria, especially the colon type, and therefore catharsis should not immediately precede operation upon the colon. The bowel should be thoroughly emptied 48 hours preceding operation, giving at least 24 hours for the intestine to become quiet. This is also advisable because of the greater ease of dealing mechanically with the bowel if its contents are semi-solid rather than fluid.

Obstruction.—The most important feature of surgery of the large intestine, taken as a whole, is the question of obstruction. The mortality of necessary operations can be closely measured by the degree and acuteness of this condition.

It happens, unfortunately, that in some cases of tumor the first important symptom is an attack of acute obstruction. This is particularly true of tumors of the sigmoid where the calibre of the intestine is more limited and the contents of a more solid nature. The obstruction interferes with the vitality of the distended intestine, renders it difficult to obtain proper asepsis during operation, and if resection is decided upon there may be considerable trouble in uniting the distended to the

collapsed · segment of bowel. If the condition is acute the absorbed toxins depress the heart's action and the abdominal distention interferes with the action of the diaphragm; if chronic the interference with the progress of the food causes indigestion, nausea, gas and abdominal distention. In suspected tumors of the large intestine careful examination should be made to arrive at a diagnosis before the stage of obstruction is reached. In the majority of instances the patient will have had symptoms upon which an early diagnosis of beginning obstruction can be made. There is, first, irregular bowel action, alternating constipation and diarrhœa with an unsatisfied feeling after stool; the movement failing to give complete relief. Second, cramps in the abdomen attended by borborygmus, and *the patient will nearly always be able to locate the site of obstruction* as it will be found at the point where the internal pressure is most intense. Third, on palpation the peculiar localized stiffening of the intestinal wall on the proximal side of the structure gives a " tumor-like feel" to the examining fingers which appears and disappears and is usually accompanied by gurgling of fluids and gases at the point of obstruction. Complete relaxation without anæsthesia can usually be obtained in the hot-water bath and a tumor, if present, can be detected. In low-lying tumors the sigmoidoscope may reach the growth. Several times I have found a sigmoid tumor prolapsed into the rectum following a large soapy water enemata, so that it could be felt with the examining finger.

The danger of drowning from the regurgitation of intestinal contents during anæsthesia should not be forgotten, and every case of obstruction should have the stomach emptied previous to operation. As a matter of fact, by careful attention to emptying the stomach and the use of saline enematas, a great many patients can be tided through a serious attack of obstruction, and the operation performed later under more favorable conditions.

The Incision.—In proposed resection of the large intestine the incision should be placed to the inner side of the seat of the

disease. If the diagnosis has not been established it is best to make a median incision through which the hand can be used to explore the abdomen. A second working incision can then be made at the most convenient situation. The utmost care must be taken to prevent infection from intestinal contents. If the proximal gut is greatly distended it will be best to make a temporary incision into it at a point where the mesocolon is sufficiently long to allow its being drawn well out of the abdomen, and with a tube empty the contained material after the method of Monks. Treves states that emptying the dis-·tended intestine at a point above the obstruction has reduced the mortality of operations one half, in acute conditions.

Mobilization.—The most important technical feature is mobilization of the large intestine for purposes of operation. The large intestine has a very long mesentery because all of its blood, nerve and lymph supply lies in the inner leaf of the mesentery and arises from the abdominal aorta and vena cava or in that vicinity. It is true that the outer leaf of the mesentery is exceedingly short, if not absent, in the ascending and descending colon and iliac sigmoid; but as the outer leaf contains no structures of importance it is only necessary to divide it, lift the colon from its bed and swing it on its inner leaf to the midline. Therefore, the *sine qua non* for efficient operation is to locate the lesion, divide the peritoneal reflection to the abdominal wall, which mobilizes the part and allows it to be completely drawn outside of the abdomen where it can be adequately surrounded with aseptic pads for clean work. By holding the color up to the light the blood vessels can be identified in the inner leaf of the mesentery, and caught, tied and divided. Mr. Moynihan shows that in this way even the descending colon may be mobilized so that it can be anastomosed with the rectum or even brought down to the sphincter muscles. The transverse colon can be readily mobilized by dividing the gastrocolic omentum.

In separating the colon and ligating the blood vessels there are some structures that must be identified.

First, the *duodenum*, a portion of which is bared in making

a proper exposure of the ascending colon and the hepatic flexure. For this reason great pains should be used in the ligation of the right colic and right branches of the middle colic vessels so the duodenum will not be injured or caught in the teeth of the forceps during operation (Fig. 2).

Second, the *ureters* must be identified and separated from adherent growths of the ileocæcal coil and ascending colon on the right side, on the left from the descending colon, and especially from the sigmoid. It must not be forgotten that just after the ureters cross the common iliac vessels they are adherent to the peritoneum and that as the colon is mobilized and pushed toward the median line the ureters go with it. Almost invariably the left ureter will be carried with the sigmoid and should be identified and separated before the resection is commenced (Fig. 2).

Third, the vasa deferentia are closely associated with the lowest sigmoid and rectum and while not so important, they should be protected from accidental injury.

The mobilization of the lowest sigmoid is readily effected by incisions along the broad ligament just under the ovaries and tubes in the female, or at the same situation in the male. These are joined by a transverse incision at the bottom of the Douglas pouch. By identifying and separating the ureters this entire portion of the bowel can be lifted cleanly from the hollow of the sacrum. The superior rectal artery comes readily with the intestine, but the middle sacral, which is usually present, and may be of considerable size, must be caught and tied.

In the removal of malignant growths of the large intestine, it will sometimes be found that a neighboring viscus has become involved and is attached to it. If conditions otherwise are favorable this should not be looked upon as a contraindication to operation. We have in such cases five times resected portions of the small intestine, on two occasions resecting two entirely independent loops of ileum, and after completing the resection of the small intestine we have removed the diseased colon with the fragments of small intestine attached.

Twice we have removed portions of the stomach which were attached to tumors of the transverse colon, and three times the bladder has been involved, necessitating partial removal of the bladder wall. One of these cases was very interesting because of the now three-year recovery of the patient after the removal of a considerable portion of the bladder wall, which was attached to and involved in a low-lying sigmoid cancer. Quite frequently in the female the ovaries, tubes and uterus become attached to sigmoid growths, and it adds but little to the difficulties and dangers of the operation to remove these attached organs from before backward in one mass with the original disease.

Method of Anastomosis.—In our experience it has made comparatively little difference by what method the anastomosis was accomplished as long as the opening was large enough. Granting that end-to-end intestinal union is ideal, the result of the lateral, or end to side, have been, functionally, just as satisfactory. In union between the large and small intestine we have usually made the lateral operation by suture, leaving as small a pouch as possible beyond the opening—and it seems to be quite immaterial whether it is made isoperistaltic or anti-peristaltic—which ever way the intestine will come together without angulation or traction; but in lateral union between two parts of the large intestine the resection should be iso-peristaltic and the openings brought close to the stump ends so as not to leave a distal pouch. Ileocolostomy is the safe operation because the contents of the ileum are fluid as compared with the solid or semi-solid character of the matter in the colon.

In end-to-end resection of the large intestine it is rather necessary for a safe anastomosis that at least one of the fragments should be well surrounded by peritoneum. In the ascending and descending colon and the iliac sigmoid, the inadequacy of the peritoneal covering may result in fistula formation, a condition which is most troublesome to heal.

For this reason in like cases resection of the sigmoid has a much higher mortality than resection of the cæcum.

The lateral operation gives very satisfactory results in such cases. If there is marked obstruction and distention, the three-stage operation of Mickulicz and Paul has much to commend it. At the first operation the tumor, with the mesentery and glands well detached, is drawn out of the wound and the proximal and distal loops united by sutures. The part to be excised is then, if possible, drawn through a separate incision in the abdominal wall of just sufficient size to carry it easily and hold it in good position. The peritoneum is united by a few interrupted sutures to the two limbs of the intestine on the inner aspect. If the symptoms of obstruction are severe, a small incision is made in the exposed mass proximal to the obstruction, and a rubber tube is introduced through which the intestinal contents are carried into a receptacle. The tumor with the attached intestine is cut away on the third to fifth day and a heavy clamp applied to the spur on the twelfth to · sixteenth day; this bites its way through about six days later.

Of late, we are doing the three-stage operation less frequently, as it does not permit of such extensive and careful dissection as is necessary for the removal of the lymph channels, and the patient is subjected not only to a tiresome convalescence and unpleasant external fecal discharge for a number of days, but a secondary operation may become necessary for complete cure on account of fecal fistula.

In all resections we now use the two-row suture method with holding-clamps, and I would say again that the importance of the method of anastomosis, whether end-to-end, side-to-side or end-to-side, has been exaggerated. The more nearly the intestine approaches the normal the better the prospects of end-to-end anastomosis, but with a distended intestine from obstruction, the less the mesenteric attachment is handled the better, and the lateral method is safe and satisfactory. On several occasions I have had an opportunity to see the result of lateral anastomosis after one year or more, and only a small elbow, at most, marked the site of the union.

In making resections one is not always satisfied with the appearance of the bowel union, and fears leakage. We have

in several instances fastened the anastomosed part to the peritoneum just underneath the incision, carrying down to it strips of rubber tissue so that if leakage occurred it could readily make its way to the surface, or the entire anastomosis can be suspended on a roll of rubber tissue in such manner that in a few hours it will become protected by adhesions to the peritoneum at the site of the abdominal wound. Gauze should not be used for this purpose as it becomes entangled in the plastic lymph and is quite often followed by fistula.

There is a group of low-lying sigmoid tumors which are exceedingly difficult to get at and where a combined abdominal and perineal operation becomes necessary. As a rule, the whole of the rectum must be removed and the sigmoid attached to the anal muscles, although occasionally the cut end can be united directly to the rectal stump by the method of Tuttle, Maunsel or Weir. After direct union between the sigmoid and rectum we have passed a three-fourth inch rubber tube with an oblique end and lateral eye from the anus upward into the sigmoid several inches above the union and fastened it by a suture to the anal margin. This tube is left from four to ten days to carry gas and fæces by the suture line. In two cases of this type we closed the end of the rectum completely, leaving it as a pouch, and made a permanent left inguinal colostomy.

The abdominoperineal operation for low-lying sigmoid growths has been unusually fatal in fleshy males. On two occasions, in males weighing 200 pounds or more, we have removed the tumor by the posterior route, by an incision which passed from the anus upward along the left side of the sacrum, excising the coccyx. The anus was closed with sutures and the rectum dissected out of its muscular bed. The peritoneum was opened in front and the entire rectum with the fat and glands lifted from the seminal vesicles, prostate and bladder. By lateral incisions the peritoneum was separated and the rectum, tumor and necessary sigmoid amputated, the proximal end of the sigmoid carried down to and sutured into the muscles below. We have followed the recommendation of Peck and left the distal end of the sigmoid closely sutured for

four to seven days following operation. In this way we have obtained complete primary union and had a fair muscular control in four weeks.

One would suppose that complete obstruction of the intestinal stump for several days would lead to great distress if not to more serious effect upon the patient, but if the bowel is allowed to become quiet for twenty-four hours before operation, and if during the time of complete obstruction the patient is kept on albumin water, strained soups, etc., the majority will go three or four days, or more, without much trouble. This effect can be continued for a day or two longer if the gas pressure becomes great, by putting a small cannula with a rubber tube attached into the projecting sigmoid stump, to carry off the gas.

In several low-lying carcinomas in the female, where the patient was very much reduced from bleeding and sepsis, we have done the Quenu-Tuttle perineal resection of the entire rectum and lower sigmoid with satisfaction.

I am quite well aware that the posterior and perineal routes are not to be recommended for sigmoid tumors, but in the obese and the very anæmic, operations of this type are well borne, and have, in our hands, been followed by complete recovery.

Any one trying it for the first time in these cases will be surprised at the ease and safety with which the rectum, sigmoid, and tumor can be removed, together with the fat and glands, to a point as high as the promontory of the sacrum.

III.—ONE HUNDRED CONSECUTIVE RESECTIONS OF THE LARGE INTESTINE IN THE ADULT.

In the 100 resections there were 12 deaths, a mortality of 12 per cent. Most of the deaths were due to sepsis and exhaustion, and they illustrate the baneful influence of obstruction which was present in nearly all of the fatal cases. This brings up the question as to whether preliminary colostomy or enterostomy is generally advisable as a preparatory measure in severe obstruction.

When it is possible, we prefer to resect at the primary operation, contenting ourselves with emptying the proximal side of the intestine of its contents. But if the intestinal wall is thickened and soggy, threatening the security of the suture line, a preliminary colostomy is advantageous. The opening is not, as a rule, closed at the time of resection, but is allowed to remain open as a safety-valve and closed later if necessary.

Of the 100 resections 61 were for malignant disease with 8 deaths, and 39 for benign conditions with four deaths. Surgically speaking, it is wise to consider malignant disease of the colon in three anatomical groups.

GROUP I. *Cancer.—The Cæcum and Ascending Colon* was removed for cancer 24 times with 3 deaths. Twenty-three were carcinoma with 2 deaths, and 1 sarcoma with no operative mortality.

GROUP II.—*The Transverse Colon,* including the hepatic and splenic flexure, was removed for carcinomatous neoplasm 7 times with 1 death.

GROUP III.—*The Descending Colon and Sigmoid* was excised for carcinoma 30 times with 4 deaths.

GROUP I. *The Cæcum* (Figs. 3 and 4).—The ascending colon is classed with the cæcum because many cancers involve the margin of the ileocæcal orifice and extend upward into the ascending colon and downward into the cæcum, therefore possibly involving the ileocolic and right colic group of glands.

The first step in the resection of the head of the colon is to liberate the cæcum and ascending colon by an incision through the outer peritoneal attachment, and with a piece of gauze the intestine with the tumor and fat is wiped cleanly to the muscles as· far as the superior mesenteric origin of the ileocolic and right colic vessels, which are tied at once, enabling a sure dissection of the mesenteric glands and fat.

The greater ease and safety with which union between the small and large intestine can be secured as contrasted with resection in continuity of the colon, is of great technical advantage. This is equally true of resection of the hepatic flexure. Looked at from a purely technical standpoint, a car-

cinoma existing at any point between the ileocæcal orifice and
the juncture of the right with the middle two-thirds of the
transverse colon can be most safely treated by complete resec-
tion of all the large bowel up to that point, and this also most
effectually removes the lymphatics.

FIG. 3.
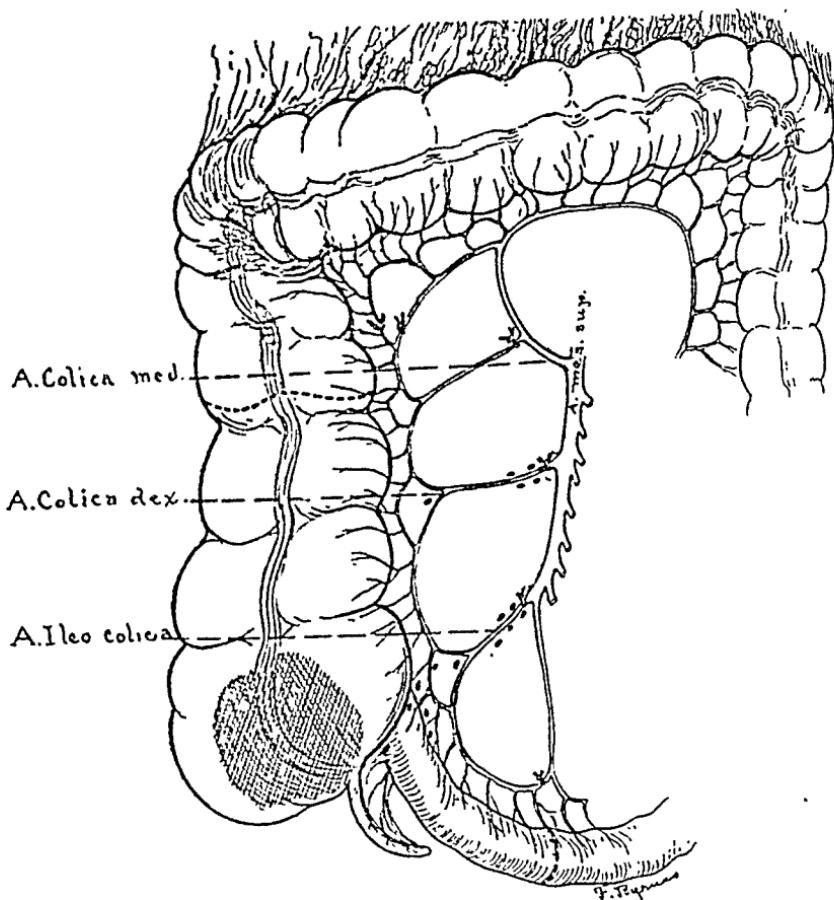
Carcinoma of cæcum. Dotted lines show lines of resection.

In carcinoma of the cæcum it is necessary to remove the
ileocæcal group of glands with the ileocæcal mesentery, and,
therefore, not less than the terminal 6 inches of the ileum must
be excised. The ascending colon should also be excised in
order to secure the right colic vessels and tributary glands.

The type of disease was usually found to be *adenocarci-
noma* and the ileocolic glands were nearly always affected.

In some specimens the disease appeared to have had its origin in the appendix. However, the appendix was so thoroughly involved as to make it impossible to arrive at any accurate conclusion on that point.

In the past three years we have operated upon and recognized microscopically six cases of primary appendiceal carcinoma, one-fifth of one per cent. of the total operations for appendicitis in that time. As pointed out by Harte, cancer of the appendix is usually of small size, not larger than a pecan

FIG. 4.
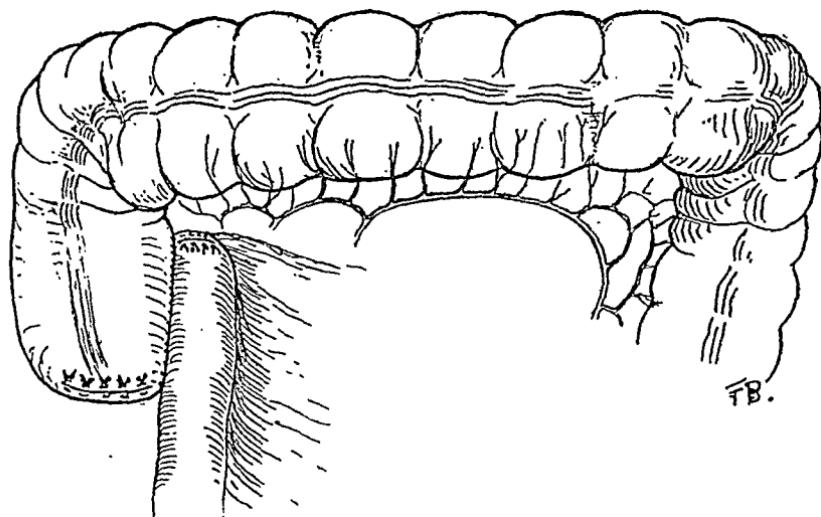
Lateral anastomosis following excision of cæcum and ascending colon, between lower ileum and hepatic flexure.

nut. It is seen most frequently in the second and third decades as contrasted with adenocarcinoma of the cæcum, which is most frequent in the fourth and fifth decades of life. Primary carcinoma of the appendix is of the spheroidal or basal-cell type. It seldom involves the lymph nodes, although LeConte reports one such case. In two of our cases the microscopic resemblance to endothelioma was striking. While in our cases of primary carcinoma of the appendix the cæcum was usually partially resected, they are not included in the statistics as the continuity of the intestinal canal was not affected by the operation.

GROUP II. *Cancer of the Transverse Colon and Flexures* (Figs. 5 and 6).—In this group there were 7 cases with 1 death. The percentage of inoperable carcinomas of the transverse colon in which no operation could be done was higher than in any other group, as there appeared to be relatively early involvement of the lymph nodes about the head of the pancreas.

In resections involving the middle of the transverse colon, the middle colic artery should be ligated early and the separa-

FIG. 5.
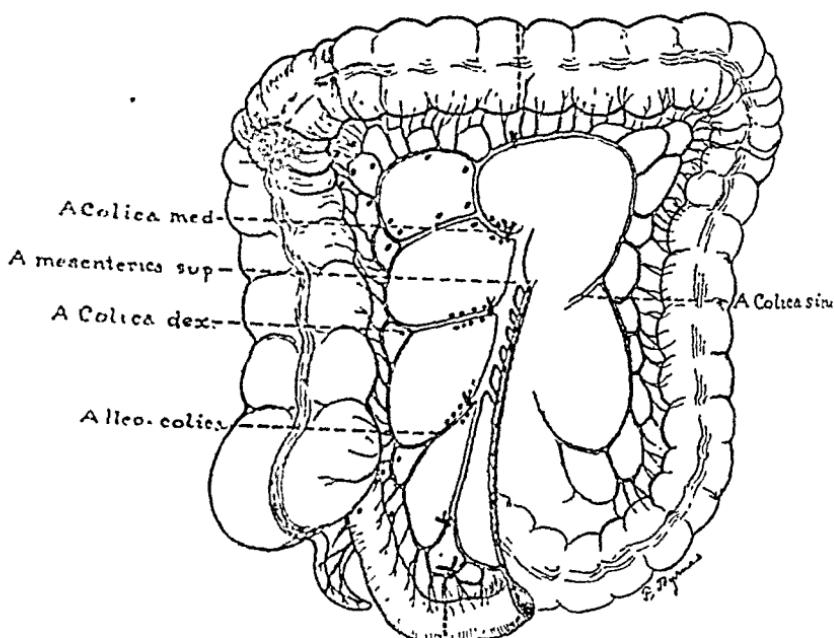
Cancer of hepatic flexure. Dotted lines show proposed resection.

tion of the glands started with that vessel. This will at once show the extent of the devitalized colon which must be removed.

Involvement of the splenic flexure is prone to early and extensive adhesions, and local extension along these pathways of the carcinomatous process is a more frequent bar to resection than lymph metastasis. If the costocolic ligament and the outer peritoneal attachments are divided as the first step of the operation, the splenic flexure is liberated, and with the

glands and fat can be drawn well out of the abdomen, and early ligation of the right and left colics at proper points facilitates further manipulations.

GROUP III. *Cancer of the Descending Colon and Sigmoid* (Figs. 7 and 8).—In this group there were 30 cases with 4 deaths. The steps of operation are similar to those

FIG. 6.
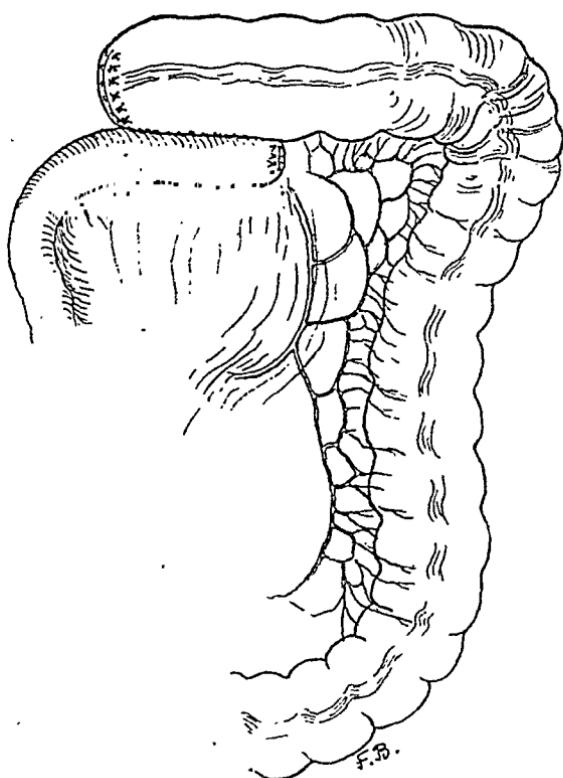
Lateral anastomosis following resection of hepatic flexure between lower ileum and transverse colon.

of the cæcum and ascending colon. Liberation by division of the outer peritoneal folds, and early ligation of the blood vessels at their origin, enables easy removal of the glands and fat so that resection can be completed outside of the abdominal cavity. Ideal resections with complete removal of the lymphatic tributaries may necessitate ligation of the inferior mesenteric vessel on account of the importance of securing that gland, which, according to Moynihan, almost

invariably lies at its origin. Wide removal of the peritoneum and surrounding fat is as necessary as the removal of the glands.

Resections for Benign Disease of the Large Intestine.— Of the 39 resections for benign conditions, 2 involved the

Fig. 7.

A.Colica med.
A.mes.sup.
A.Colica dex.
A.Ileo-colica

A.Colica sin.
A.mes.inf.
A-A. sig.
A. Rect. sup.
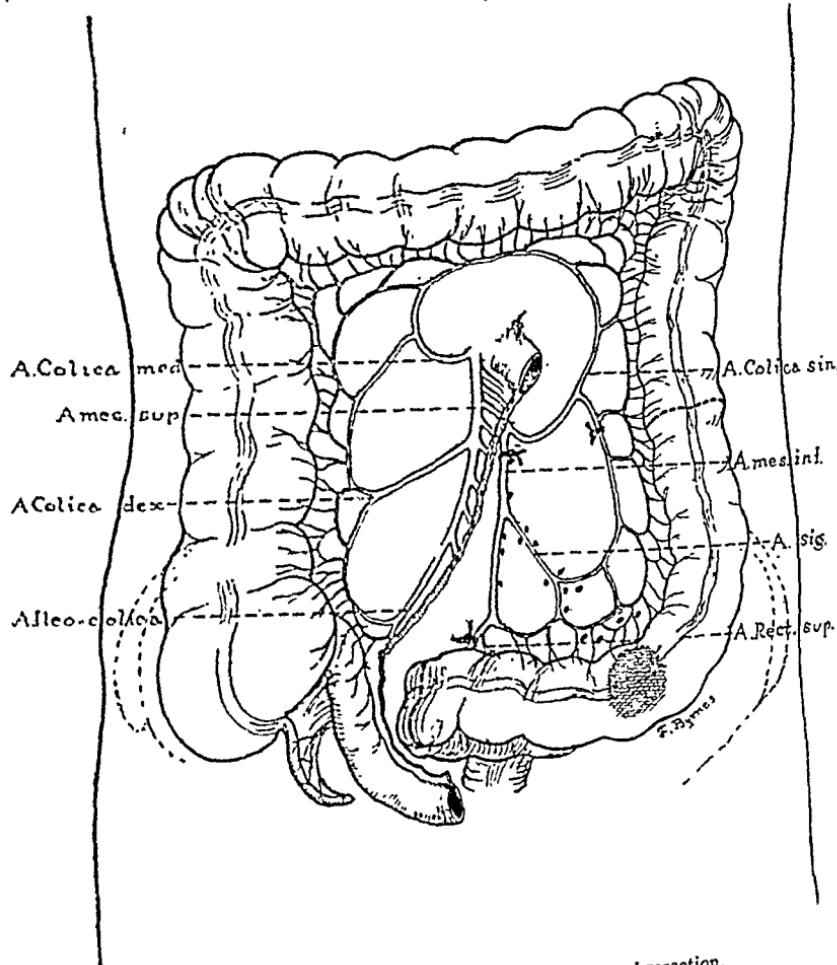
Cancer of sigmoid. Dotted lines show proposed resection.

entire colon; both recovered. Twenty-four involved the cæcum and ascending colon with 1 death. Two of the transverse colon with 1 death, and 11 of the sigmoid with 2 deaths.

GROUP I. *Two Colectomies for Chronic Ulcerative Colitis.*—Nearly all the colon was removed; both made a good recovery.

GROUP II. *Cæcum and Ascending Colon.*—There were 24 resections of the cæcum and ascending colon with 1 death.

(a) *Inflammatory Disease,* 11 with 1 death.—This group is made up of an assortment of inflammatory conditions in which the continuity of the bowel had been destroyed by infection or its results, such as, sloughing causing large fecal anus at the ileocæcal juncture, impossible of closure by plastic operation.

FIG. 8.
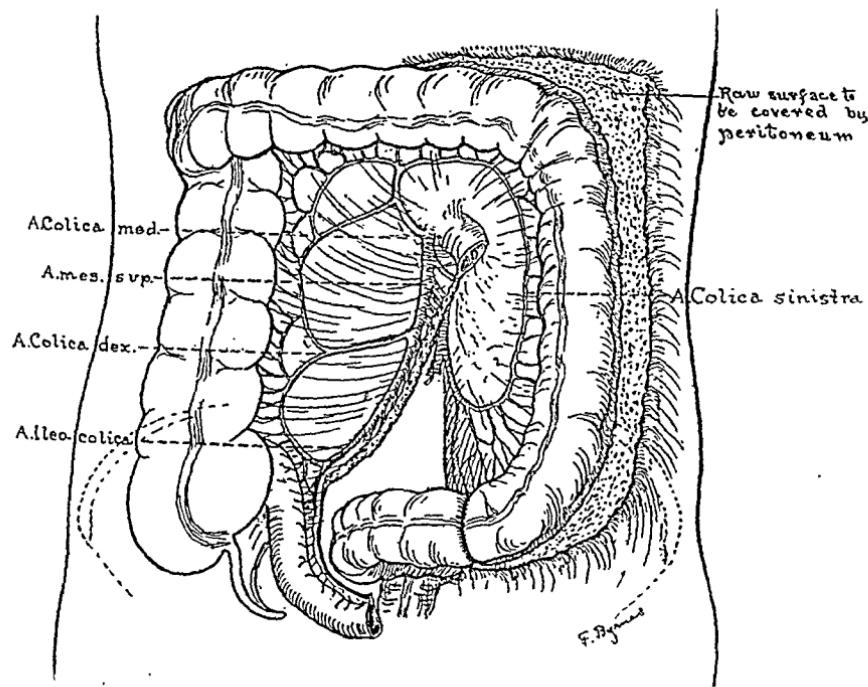
End-to-end anastomosis following resection of sigmoid. Note mobilization of splenic flexure and descending colon.

Three of the latter resections required simultaneous resection of the sigmoid because of previous attempts, not in our clinic, at closing the fecal anus by anastomosing the cæcum to the sigmoid. Attempts to cure fecal fistula by performing lateral anastomosis with the view that short circuiting would permit the fistula to heal is usually a mistake. If there is no obstruction, the vermicular action of the intestine constantly tends to carry the ingesta past the artificial opening along the normal lines of the bowel, and not only is the patient not cured

of the disease but a serious complication is added when later it becomes necessary to operate for a definite cure of the lesion. It is a simple matter to circumscribe a fecal fistula by an incision down to the peritoneum at some point outside of the intestinal adhesions and introduce the finger as a guide. The less firm adhesions are swept loose and the circumscribing incision deepened through into the peritoneal cavity. The intestinal loop containing the fistula can be drawn out upon the surface of the abdomen, surrounded with gauze and the fistula closed in the long axis of the intestine by two rows of sutures, the outer row preferably of interrupted linen or silk.

(b) *Intussusception.*—A benign fibromyoma of considerable size growing from the vicinity of the ileocæcal valves and projecting into the lumen of the cæcum, causing intussusception, was subjected to resection with cure.

(c) *Localized Tuberculosis.*—Twelve cases with no deaths. Tuberculosis of the ileocæcal coil occurs in two forms—ulcerous and hypertrophic. Only one of the ulcerous type was subjected to excision, although a few patients were seen who, when they came under observation, were in a poor general condition with extensive fistulous tracts associated with multiple tuberculosis in the small intestine, and usually with pulmonary involvement. Eleven of the resections were for hypertrophic tuberculosis with well marked tumor, and in the majority it was difficult to differentiate them from carcinoma at the time of the operation.

In addition to these 12 cases in which resection for tuberculosis was performed there were a number in which the local condition was looked upon as being inoperable and some form of exclusion operation was made as a palliation for obstruction. This was particularly true in our early experience before we became aware of the extent to which these operations could be carried, also because we looked upon irremovable lymphatic glands to be a contra-indication to resection. In several instances we have removed hypertrophic tuberculosis of the cæcum with the ileocolic glands, and have left huge tuberculous glands extending up along the aorta as high as the

diaphragm, their size varying from that of a walnut to an egg, with complete and permanent cure of the patient. Shutting off the supply of infection evidently enabled nature to overcome the poison which had already been absorbed into the glandular system. In several of the specimens the bovine type only of tubercle bacilli were found to be present.

In 54 cases, 1 per cent. of the total number of appendectomies, the appendix was the seat of tuberculosis. The cæcum was nearly always involved at the base and extensively removed. These cases are not included in the statistics because the continuity of the bowel was not interfered with in the operation. Many were apparently the original focus of an extensive tuberculous peritonitis and the operation was undertaken for this symptomatic condition.

GROUP II. *Resection of the Transverse Colon.*—The transverse colon was resected twice for benign disease, once for diverticulitis and once for fibrolipoma, with 1 death.

GROUP III. *Sigmoid.*—The sigmoid was resected 11 times with 2 deaths. (*a*) In one case of Hirschsprung's disease, or giant colon, the sigmoid with the ascending and transverse colon was excised with cure. (*b*) Fibrolipoma, 1 resection with recovery. (*c*) Two for tuberculosis, 1 of the ulcerous type and 1 of the hypertrophic variety; both recovered. (*d*) Five were for diverticulitis with two deaths. This lastnamed condition is very curious and is due to pouching of the mucous membrane through small defects in the muscular coat of the colon in which fecal concretions form and result in acute or chronic inflammation. A well defined tumor is usually to be felt which is tender during the acute stage and accompanied by mild general symptoms of infection. These tumors have often been diagnosed as carcinoma, and in three out of five resections for this condition in the colon the diagnosis was only cleared up with the microscope. For a full report of five of these cases see article by Mayo, Wilson and Griffin, in *Surgery, Gynecology and Obstetrics,* July, 1907.

The sigmoid was resected for inflammatory pelvic disease two times with recovery.

8

In the group of resections we have not included a considerable number in which the sigmoid was more or less involved or injured in the course of operation for diseases of the pelvic organs, as the consideration of these should be undertaken in connection with the diseased processes of which they were the accidental rather than a primary part.

I am indebted to Dr. M. S. Henderson for compiling the following table of statistics from the records at St. Mary's Hospital, and also for the correspondence involved in ascertaining the present condition of the patients.

ONE HUNDRED CONSECUTIVE RESECTIONS OF THE LARGE INTESTINE IN THE ADULT.   OPERATIONS PERFORMED AT ST. MARY'S HOSPITAL, ROCHESTER, MINNESOTA, BETWEEN FEBRUARY, 1898 AND FEBRUARY, 1909.

Of the 100 resections 61 were for malignant disease with 8 deaths (13 per cent.).

CANCER OF THE CÆCUM AND ASCENDING COLON.

Number of cases	24
Male	17
Female	7
Age of oldest	72
Age of youngest	31
Average age	48
Patients of ages between 30 and 40 years	7
Patients of ages between 40 and 50 years	11
Patients of ages between 50 and 60 years	2
Patients of ages between 60 and 70 years	3
Patients of ages between 70 and 80 years	1

Average duration of symptoms 13 months.

Operative mortality ....(12.5 per cent.)	3
Patients dying within 1 year after operation	1
Patients dying between 1 and 2 years after operation	3
Patients alive less than 1 year after operation	2
Patients alive 1 to 2 years after operation	2
Patients alive 2 to 3 years after operation	3
Patients alive 3 to 4 years after operation	2
Patients alive 4 to 5 years after operation	1
Patients alive 5 to 6 years after operation	1
Patients alive 6 to 7 years after operation	1
Patients alive 7 to 8 years after operation	1
Number not located	3
Total	24

Of 11 patients operated upon more than 3 years ago, 10 have been traced. Six, or 60 per cent., are alive and well to date.

CANCER OF THE TRANSVERSE COLON INCLUDING THE HEPATIC AND
SPLENIC FLEXURES.

Number of cases.. 7
Male 2
Female 5
Age of oldest.. 66
Age of youngest.. 35
Average age 52
Patients of ages between 30 and 40 years............... 1
Patients of ages between 40 and 50 years............... 2
Patients of ages between 50 and 60 years............... 2
Patients of ages between 60 and 70 years............... 2
Average duration of symptoms 16 months.
Operative mortality..........................(14 per cent.) 1
Patients dying 1½ years after operation................ 1
Patients dying 2   years after operation............... 1
Patients alive and well 1 year after operation......... 2
Patients alive and well 3 years after operation........ 1
Number not located..................................... 1
Total 7

CANCER OF THE SIGMOID.

Number of cases.. 30
Male 21
Female 9
Age of the oldest...................................... 71
Age of the youngest.................................... 31
Average age 52
Patients of ages between 30 and 40 years............... 5
Patients of ages between 40 and 50 years............... 7
Patients of ages between 50 and 60 years............... 8
Patients of ages between 60 and 70 years............... 8
Patients of ages between 70 and 80 years............... 2
Average duration of symptoms 2 years.
Operative mortality..........................(13 per cent.) 4
Patients dying 1 year or less after operation.......... 3
Patients dying 1 to 2 years after operation............ 5
Patients dying 2 to 3 years after operation............ 1
Patients alive and well 1 year after operation......... 7
Patients alive and well 1 to 2 years after operation... 5
Patients alive and well 2 to 3 years after operation... 2
Patients alive and well 3 to 4 years after operation... 3
Total 30

Out of 6 cases operated upon more than 3 years ago, 3, or
50 per cent., are alive and well.

RESECTIONS FOR BENIGN DISEASES OF THE LARGE INTESTINE.

DISTORTION OF THE MESENTERY AND ITS RELATION TO INTESTINAL OBSTRUCTION.*

BY JOSEPH D. BRYANT, M.D.,

OF NEW YORK,

Surgeon to Bellevue and St. Vincent's Hospitals.

FOR the purposes of this occasion, Distortion of the Mesentery is considered to mean the twisting or otherwise forcing out of shape of the mesentery by disease process, and thereby so disarranging its normal relation with the attached intestine as to change the orderly course of the latter with reference to it. Torsion of the mesentery, as commonly expressed, is not included in this title. It seems not at all unreasonable to conceive that the forcing out of shape in this manner of the mesenteric curtain, to the lower border of which the intestine is attached, would change the normal relations existing between them to a sufficient degree as to modify correspondingly the functions of the included intestine.

The stimulus prompting the conception of the title and promoting the birth of this paper, had its origin in the strikingly interesting, and, to me, instructive features incident to a case recently coming under my notice from lay sources, which was characterized by long-standing and progressively increasing symptoms indicative of intestinal obstruction. The nature of the obstructing cause was at first problematical, being regarded as functional; then, as functional with organic complications, the latter of which finally dominated the varying picture of distress so long as the patient remained under observation. It, therefore, naturally follows that the syndrome of this case is divided into two parts, viz.: the early or the recounted part, and the later or the observed part, at least, so far as the writer is concerned. And, in expressing the indications of disorder in this instance, especially those manifestations will be told which are regarded as not being inconsistent with a belief in the peculiar nature of the obstruc-

* Read by title before the American Surgical Association, June 3, 1909.

tion, and its probable location. A plan like this necessarily eliminates, except for comparison, many of the multitude of common symptoms of intestinal obstruction, and correspondingly abbreviates and emphasizes the text and the facts that are regarded as being expressly related to the problem.

It appeared, in this instance, according to the recounted symptoms, that, at longer or shorter intervals of time for several years, there had occurred brief attacks of intestinal colic usually accompanied with nausea and vomiting, as the distinguishing traits. The frequency and severity of the attacks, though differing in degree from time to time, gradually increased in these respects, until the uncertainty of the time of their coming and going, and of their severity, obviously founded a most unhappy and insecure state of affairs. Usually, in these instances, however, a mild anodyne, supplemented with a gentle cathartic, afforded prompt relief—a relief commonly marked by copious evacuations of semi-solid material, sometimes with distinctive features of indigestion, but with no evidence of obstruction. Afterward, however, a decided change occurred in this, the negative feature of the case. For, in an attack apparently induced, as often before, by indiscretion in diet, it is recounted that there developed after twenty-four hours, genuine symptoms of intestinal obstruction, which refused obedience for forty-eight hours longer to the usual remedial means employed in these instances. Soon after, however, a copious bowel evacuation succeeded an escape of offensive flatus, the apparent sequel of a deferred, hopefully employed, high enema. Complete comfort followed at once. But, singularly enough, within an hour after the stool, nausea ensued which was promptly and finally relieved by abundant vomit having a distinct fecal odor. Also, it is told that during the height of this attack, the turpentine and the asafœtida separately employed in the high enemata for the purpose of fecal dislodgement were tasted by the patient soon after their introduction. A fact which happened thereafter, it is said, on two occasions with the use of asafœtida with a similar intention. After the prompt subsidence of this attack, I was told that comparative quiet reigned in the abdominal affairs of the patient for nearly eighteen months. Before, during, and subsequent, to this attack, nothing of diagnostic significance related to the affliction, could be ascertained by physical examination so long as the

patient came under our notice. Later, the painful digestive attacks increased in frequency, happening once in four or five weeks, in fact, were not infrequently prompt complications of slight constipation and of errors in diet. And, too, before final relief from an attack came in sight, fecal vomit in varying amounts was in evidence—at least, once in three or four months. And, at one time, the attacks bid fair to wear the patient out through the torment of spirit and physique, which they imposed at uncertain intervals.

The pain was rarely severe, it being often readily controlled by a small amount (⅛ or ¹/₁₀ grain and less) of morphia, given hypodermically once in six or eight hours. The pain was located primarily, and throughout the attack, in the navel region. It sometimes came suddenly without premonition; again with a sense of indefinite gastric or abdominal distress; and often in a gradual manner, with or without important manifestations. Some general tenderness of the abdomen was present, especially if the attack was severe, but no circumscribed points of tenderness could be determined in slight or severe attacks until late in the history of the case, when, after severe attacks, varying and vague points of tenderness were noted only in the navel region. The region of the appendix and of the gall-bladder, however, was free from all uncomfortable manifestations. Local or general tension of the abdominal muscles was never observed. Tympany was absent during slight attacks, and was not pronounced during the severe. The pulse exhibited but little change from normal, except during the later part of my observation, when it, very naturally, was accelerated by pain and fever. The temperature (rectal) rarely reached 100 F. until during the later attacks, when it would go up a degree or two, and even higher, and then suddenly fall a degree or more in a few hours (6 or 8) before the symptoms of obstruction were relieved, usually by copious alvine dejections. So constant was this phenomenon in these later attacks as to become of special significance as indicating approaching relief. During the last two attacks known to me, the remission was quickly followed by abdominal pain, and return of temperature which, soon after, resumed the usual low figure of the preceding attacks. It would seem as if in these special instances, brief arrest of recovery had happened, resulting, perhaps, in slight re-obstruction and consequent increased degree of infection. Especially so, since their temperature of 103 F. and 104

F. for a short time, would then suddenly fall to nearly normal, attended with perspiration. Nausea was common with the onset of the pain, and often vomiting, the vomit being composed usually of the contents of the stomach, followed by bile. In several instances, however, the vomit became fecal, sometimes very promptly and unexpectedly, and once, primarily, then again, later in the course of the attacks. In one instance, free fecal vomiting, and a simultaneous large stool terminated at once a seventy-hour period of apparent obstruction. In this instance, the physical characteristics of the two discharges, oral and anal, were similar in color, odor, and consistency. The color was brown, the odor fecal, and the consistency semifluid. A chemical examination of these discharges disclosed the presence of indol and skatol in each, and with but little more of these agents in the stool than in the vomit,—a difference which, at the time, might well have prompted the thought that the intestinal obstruction, in this instance, divided somewhat equally the field of abnormal development of these substances. For, were the obstruction located at the proximal side of the region of development, one would not expect the presence of either substance in the vomit.

In the majority of attacks, the symptoms of intestinal obstruction yielded quite promptly to high enemata and colonic irrigation. At times, however, these agents produced no apparent effect, even on repeated employment. It sometimes would seem as if the obstruction—at uncertain periods (30 to 75 hours after attack)—would yield more to intestinal effort than to human contributing influences. That is to say, the morbid physiology of the intestine itself apparently was more potent for relief on these occasions than were the special efforts of those in charge of the case. In one instance, however, when other measures afforded no relief, two quarts of warm sweet oil, slowly introduced as high as possible into the bowel, were, in the course of an hour, followed by copious discharges of soft fecal content, succeeded by prompt relief lasting for a brief period. A curious sequel to this experience was the frequent passage in the stools for about twenty-four hours, of varying small amounts of sweet oil. It appeared as if the oil had been sequestered in the bowel, so as to be returned in divided portions from time to time, as the actions of the bowel would require. Also a manifestation which pointed to the presence of isolated collections of fecal matter in the small intestine, happened in two instances later in

the history of the case in the following way: The administration of a saline cathartic was followed promptly only by brown watery evacuations strongly impregnated with indol and skatol. This result would not be expected in the instance of an empty colon already rinsed well by saline catharsis and irrigation. In these instances, however, a liberal dose of castor oil was promptly followed by a large soft fecal evacuation. It therefore appeared as if the fluid dejections had passed across or through disseminated accumulated fæces in the small intestine, thus staining and impregnating them with indol and skatol. For, had the amount of fecal gathering disclosed by the cathartic been circumscribed in the small intestine, there is no doubt that tumor would have been present on manipulation, hence the belief in circumscribed dissemination. In the second instance, after ingestion of milk the rapid appearance per anum of milk-colored discharges followed by an abundant fecal movement from castor oil, suggested the presence of fecal accumulation in the small intestine, especially when the colonic irrigating fluids, just before employed, had been returned uncolored. Again on frequent occasions, test doses of two grains of bismuth by mouth, in the instance of fluid diarrhœa, promptly discolored the anal discharges, thus clearly demonstrating the fact of incomplete obstruction and the absence of a special diarrhœa of irritation from below. And, too, following this, the normal fecal discharges returned without the help of remedial agents, suggesting the further idea that but little, indeed, of the fluid discharge could have come from a local intestinal irritation caused by a fecal accumulation.

It is but fair to say at this time that careful observation and study of the phenomena noted in this case, convinced the writer that, for some reason, an S trap-like arrangement in the course of the small intestine was present, and likely, too, in plural number, at the lower curves of which passing fecal matters accumulated sufficiently on different occasions to cause more or less, and sometimes complete obstruction, often accelerated by indigestible matters of sufficient amount or suitable size, to completely and suddenly occlude the remaining part of the lumen. More often, however, it was believed that the pockets were emptied by local intestinal muscular contraction with more or less pain attendant thereon, and, at other times, wholly, or in part by the aid of cathartics, more especially castor oil. As already intimated, it was believed that at times an incomplete occlusion was present,

leaving only sufficient space to permit of the passage of saline
evacuations over the fecal accumulations in the dependent parts
of the receptive loops of the deformed intestine, thus tincturing
the passing fluid with indol and skatol. The prompt passage, at
times, of undigested milk and of bismuth-stained fluids for test
purposes also served to substantiate the belief in incomplete ob-
struction. And, too, on careful thought no other form of intes-
tinal obstruction appeared so well to meet the syndrome of this
case. It was not improbable that this obstruction was lo-
cated in the ileum not far from the cæcum, and also that the
ileocæcal valve at times was pervious to fluids from below, and
that active reverse peristalsis was a prominent feature.

It should not be amiss now to further interpret, so far as
practicable, the other various phenomena which pointed
toward and added interest to the pathologic picture just
sketched.

The tasting on different occasions of the turpentine and
asafœtida employed in high enemata for the purpose of over-
coming intestinal obstruction, suggests at once that the
obstruction could have not been complete, though so regarded
at the time. Also, that reverse peristalsis had been rapid and
pronounced at the time, as taste of the drugs happened during
the brief retention of the enema. And, besides, for some
reason, the ileocæcal valve was not on guard in a manner
commonly supposed to characterize its office. In this connec-
tion, however, it is proper to say that intestinal peristalsis is
not as simple a mechanism as is commonly supposed, and that
antiperistalsis especially is a phenomenon the intricate nature
of which is, as yet, not entirely settled.

Practically, however, antiperistalsis is reported as having
carried nourishing and medicated agents from the rectum to
the mouth in a brief time in many instances. The writer in
1892, in a hysterical patient, observed the vomiting from a
test glycerine and methyline violet enema twenty seconds after
its introduction into the bowel. A suspected communication
in this case between the colon and the stomach was disproved
by explorative examination. About the same time, the at-
tachment of the divided ileum to the sigmoid flexure was
practiced by the writer in order to short-circuit the intestinal

contents in the instance of an obstinate fecal fistula of the transverse colon. But, only a change in the consistency of the fecal discharge was observed, as the soft discharges of the ileum were carried up the descending colon by retrograde peristalsis, and escaped as before from the cutaneous opening of the fistula. Also, as a matter of established fact, and apparently shown by this case, a continuous peristalsis going rapidly from the rectum to the stomach, and, another kind arising at an irritated part of the intestine, and going from it in opposite directions may take place.

That the inhibitory influence of the ileocæcal valve on peristaltic intercourse of the large and small intestines cannot be regarded as definite, is evidenced by the report that in 60 per cent. of subjects (Debierre) the valve is found to be permeable from below.

It seems permissible now, to point again and more fully to symptomatic features of the case which had been regarded as being of special significance in connection with the peculiar form of obstruction to which they had been assigned. Among them may be classed the nearly equal amounts of skatol and indol contained in the fecal matters simultaneously discharged from the mouth and anus. Of course, I was aware of the flood of fallacies that beset this proposition, but, it came to my mind and was not dismissed. The normal habitat of these diagnostic products of fecal substance is peculiar to the cæcum and the first part of the colon. And, in this instance, it appears that the ileocæcal valve was pervious from the colonic side. Therefore, at first sight, it could be easily said that primarily both oral and anal dejections were largely the product of cæcal and colonic activities, whose respective exits were made possible by the presence of an obliging ileocæcal valve. But, if such had been the case, the amount of skatol and indol in the oral dejection might well have exceeded that of the anal, since, to the contents of the cæcum and nearby colon are these products easily peculiar. But inasmuch as the processes of decomposition breed skatol and indol anywhere in the intestine, in amounts proportionate to the contributing influences, and, as in this instance, the putrefaction changes

were general throughout, and, also, that an incomplete hindering obstruction of some sort was lying between the cæcum and the stomach, it was not singular, and one would expect the greater amount of these products to favor the anal exit of the area of their natural production. Also, classed as indicating the possible location and probable mechanism of the obstruction, will be recalled certain facts already stated in the early history of the case viz.: The slow development, too slow, in fact, for the progress of the common kinds of intestinal obstruction. And the associated indications conform therewith. The phenomena recounted regarding the high sweet oil enema; the colonic irrigations; the skatol and indol impregnations; the milk and bismuth exhibitions; the castor oil responses; the forecasting indications of spontaneous relief, etc., etc., appealed to the author with sufficient force to put in mind the theory already expressed, *i.e.*, "an S trap-like arrangement of probably multiple parts in the course of the small intestine." This theory was promulgated before a tangible opportunity was afforded to determine the seat and mechanism of the obstruction by means of material examination. Finally, however, by so doing, it was determined that nothing physically appreciable was at fault with the colon, the cæcum, or the appendix. The first four or five inches of the ileum were normal. The succeeding seven or eight inches and the mesentery connected therewith were abnormal, the latter being distorted by chronic inflammatory process, so as to cause scalloped irregularities of the attached intestine for a corresponding distance. The wall of the intestine at this situation was much hypertrophied, thus giving rise to marked encroachment on the lumen of the gut, which otherwise was enhanced in places by the acute angles of the scallops themselves. The intestine proximate to the obstructed part was moderately dilated and hypertrophied for a considerable distance.

The marked hypertrophy which characterized the disordered part of the intestine is regarded as the natural product of its crippled condition, especially in view of the well-known fact that the interference with the normal flow of a fluid

through its natural channel at once provokes functional resentment of a greater or lesser degree on the part of the motor forces interested with the conduct and care of the function. And, also, that the effort required to keep pace with the demands of increasing interference develops the compelling forces correspondingly, as is made manifest by the increasing growth of the responsible parts engaged in the duty of functional activity and preservation.   We can quite easily understand how, as in this instance, that near-together consecutively arranged developing interferences (scallops) with intestinal function could, sooner or later, cause slight, temporary, and finally more or less decided obstruction to the flow of the intestinal contents, attended with corresponding increase in dimensions and power of the propelling force, as represented by the muscular development of the part thus directly involved.

It would appear to me that the disclosures of the examination have reasonably established the conjectural diagnosis as related to the location and the mechanism of the obstruction. Also, that the phenomena recounted in connection therewith fit the physical findings amply, certainly much better than they can be adjusted to the mechanism of a different form of intestinal obstruction.

A careful examination of the literature of intestinal obstruction as related to mesenteric distortion (not volvulus) by competent persons, reveals no instance of similar intestinal disfigurement, or of like clinical history.   In one instance only it appeared that the pressure of a large tuberculous mesenteric gland on the veins of the mesentery of the ileum had produced œdematous thickening of the walls of the corresponding part of the intestine to a degree causing sufficient closure of the gut, and modification of its functions to produce acute intestinal obstruction, for which resection of the part was made.

What I have offered, on this occasion, is most respectfully submitted, and, for the time being, is all I would care to say regarding a matter which only time and multiplied opportunities can fittingly adjust to the topic of intestinal obstruction.

I. STRANGULATED RETROPERITONEAL HERNIA OF THE INTERSIGMOID FOSSA. II. INTERPARIETAL VENTRAL HERNIA AT McBURNEY'S POINT. III. RESECTION OF FOUR FEET OF INTESTINE FOR INTESTINAL OBSTRUCTION FOLLOWING REDUCTION OF STRANGULATED HERNIA EN MASSE FOUR MONTHS BEFORE.[*]

BY WILLIAM B. COLEY, M.D.,

OF NEW YORK,

Attending Surgeon to the General Memorial Hospital; Attending Surgeon to the Hospital for Ruptured and Crippled.

I. STRANGULATED RETROPERITONEAL HERNIA OF THE INTER-SIGMOID FOSSA.

INFANT, male, born September 8, 1907, weighed 7½ pounds, apparently in every way normal at birth. The only unusual thing noticed the first 24 hours was the fact that the child cried almost constantly, and occasionally would spit up a little mucus; he had two meconium stools, passed normally. He continued to take sugar water and a mixture of 2:20 milk, without vomiting. The second day he continued to cry nearly but not quite so badly as during the first 24 hours. At the end of the second day, when the mother's milk began to come, he was put to the breast and suckled satisfactorily. There were no satisfactory bowel movements after the meconium stools, though the napkins were stained occasionally with fecal matter. I saw the child 24 hours after birth, also at the end of the first 48 hours, and could detect nothing abnormal in the abdomen. On the evening of the second day, 54 hours from birth, the nurse thought the abdomen was more distended and somewhat harder on the left side and did not think the child was exactly right. The crying continued. The baby nursed well, however, during the night; and, when seen by myself the following day at noon, 72 hours from birth, the nurse stated that the baby seemed very much better; she said it was nursing well and was getting plenty of milk from the mother. I again examined the abdomen. I found no areas of dulness and could

not make out any definite enlargement on the left side, which the nurse stated she had noticed the evening before. The movements, however, were not satisfactory.

In the evening of the third day, 80 hours from birth, the child developed a temperature of 102° and began to vomit. I was 16 miles away, but advised, over the telephone, passing a rectal tube and irrigating the bowel. The child had had a small dose of castor oil before. The nurse was unable to pass the tube into the rectum. The vomiting ceased and the child took some milk and slept a good deal between 8 and 10 P.M. The vomiting again began at 1 A.M. and during the two hours it required for me to reach the patient, he was seen by Dr. Mackenzie, the local physician, who tried to pass a catheter and wash out the bowel, but was unable to pass the tube more than 2 to 3 inches. On my arrival, at 4.30 AM., I again attempted to pass a catheter, and although I used three or four kinds—soft and hard—I was unable to get up higher than 3½ inches, from the anus. The catheter then seemed to meet with some obstruction beyond which it could not pass; no fluid could be forced beyond the catheter. The napkins were on two occasions at night stained with yellowish fecal matter, but there was no distinct movement. There had been considerable cyanosis at one o'clock, but at 4.30 the color seemed much better and the general condition was improved. Breathing, however, was rapid and heart action weak. The abdomen at the time of Dr. Mackenzie's visit, at 1.30 A.M., had been much distended and was harder on the left side, in which region, he stated, there was certainly a marked dulness. My examination at 4.30 showed the abdomen symmetrically distended, but there was absolutely no change in note on either side.

At 8 o'clock I made another attempt to irrigate the bowel, but failed; the catheter would go no further than on the previous occasion. I consulted with Dr. Chas. G. Kerley over the telephone and he advised again attempting an enema with Epsom salts and ox-gall. This was tried, but very little could be made to enter the bowel. The child gradually failed and died at 11 o'clock, before Dr. Kerley arrived. Although I was certain of an intestinal obstruction, the child was in no condition at any time since the vomiting began, to stand an abdominal operation.

An autopsy was made two hours after death, in the presence of Dr. Mackenzie of Millbrook, New York. On opening the

peritoneal cavity, an immense gush of air mixed with an emulsion of fæces poured out, causing the abdominal walls to collapse. Between a pint and a quart of yellowish liquid fæces (there was no pus or anything resembling purulent material present) was found lying in the abdominal cavity. When this was evacuated, I was immediately struck with the absence of the intestine. Careful search revealed only a small loop of small intestine, deeply congested and distended; there was, however, a globular tumor occupying the left side of the abdomen, beginning on a level with the bifurcation of the common iliac artery and extending up nearly to the costal arch. This swelling was smooth, symmetrical, and resilient on pressure. Finally, I discovered at the lower edge of the swelling a semilunar fold of peritoneum, situated a little to the left of the vertebral line and just on a level of the bifurcation of the iliac artery. This semilunar fold formed the neck of the retroperitoneal sac. The aperture was 1¼ inches in diameter, easily admitting the index finger (Fig. 1). The posterior parietal peritoneum had evidently been lifted forward, forming the hernial sac which contained almost the entire small intestine. The sigmoid turned sharply to the right and the whole large intestine was entirely on the right side. The intersigmoid fossa must have been abnormally large, containing some, perhaps nearly all of the small intestine at birth. On the other hand, it is possible that only a portion of the intestine occupied the fossa at birth and that the constant crying during the first two days may have forced more and more of the intestine into the sac until practically the whole small intestine was included and later strangulation occurred.

The opening in the peritoneum in this case corresponds very closely to that of Eve's, although in Eve's case the sac contained only a portion of the ileum, 6 inches in length.

Eve's case was a woman, 63 years of age, and there was present a band of adhesions between ascending colon and sigmoid flexure, which played some part in the etiology.

In regard to Eve's case Moynihan states that the most likely explanation is that " there had been originally a common mesentery for the jejunum, ileum, cæcum, and ascending colon. The splenic flexure and the descending colon became

FIG. 1.
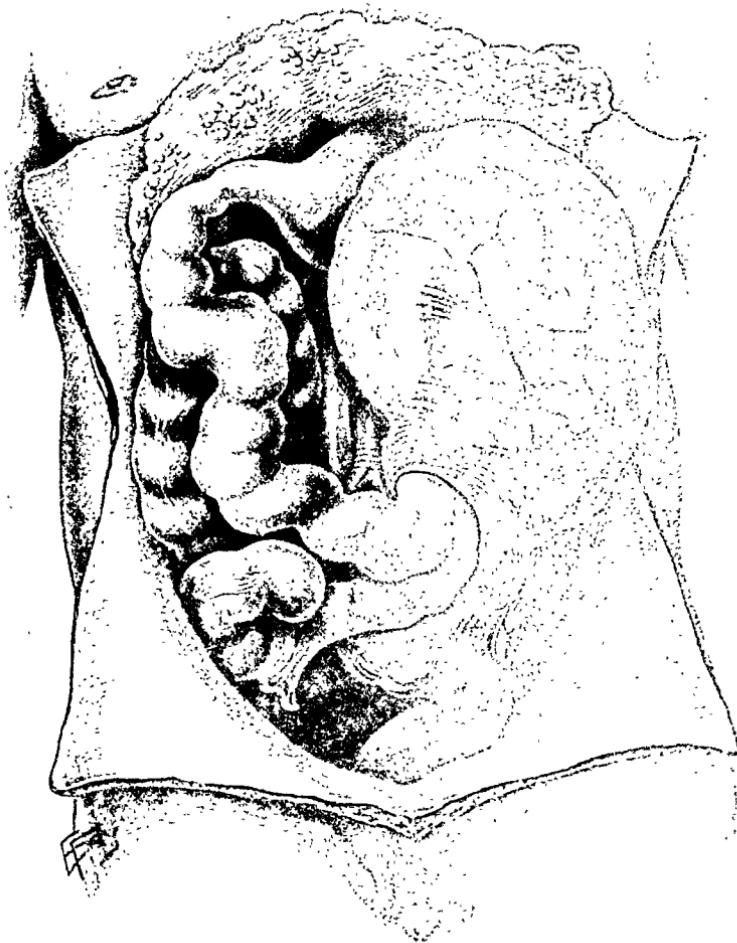
Strangulated congenital hernia of the intersigmoid fossa, in child of three days old.
(Coley).

FIG. 2.

Eve's Case.—A, Cæcum turned forwards; B, Ascending colon; C, Continuation of colon, bent on itself; D, Descending colon; E, Band of adhesion; F, Fossa intersigmoidea; G, End of ileum. (*British Medical Journal*, June 13, 1885).

fixed in the usual manner by the adhesion of the left or posterior layer of the original descending mesocolon to the parietal peritoneum of the posterior abdominal wall. As a result of peritoneal adhesion, most probably pathological, the cæcum and ascending colon had adhered to the descending colon and the sigmoid, and the united gut had been dragged over to the right, laying bare and rendering patent the orifice of the intersigmoid fossa."

In the character and amount of contents my own case corresponds very closely to the case of Treitz, a duodeno-jejunal or mesocolic hernia. (*La Progrès Médicale*, 1889, tome ii, p. 289.) In Treitz's case the opening of the hernial sac was in the median line a little higher up and the long diameter was perpendicular instead of horizontal. In addition, the transverse and descending colon surrounded the tumor on the upper left and lower side.

My case, as far as I can learn, is the only case of intersigmoid hernia, or for that matter, of retroperitoneal hernia existing at birth. While it is possible that, had the condition been recognized on the first day, an immediate operation might have been successful, still, the difficulties in the way of an early diagnosis in such a young infant must be regarded as very great. In this case there was no localized tumor; the child continued to take food until near the end and vomiting was a very late symptom.

The only three cases of hernia of the intersigmoid fossa that I have been able to find are the cases of Eve, McAdam Eccles, and Lambret. The two former were referred to at length by Moynihan in his well-known work on " Retroperitoneal Hernia." As to Lambret's case, Moynihan stated that he was unable to obtain the journal in which it was reported, namely, *l'Echo Médical du Nord*, 1897, p. 384.

Mr. F. S. Eve regarded his case as the first authentic case of intersigmoid hernia. It was reported in the *British Medical Journal*, June 13, 1885. The specimen has been preserved at St. Bartholomew's Hospital.

This fossa was first described by Hensing and consists of

a pouch or depression of the peritoneum forming the left or under layer of the mesosigmoidea, extending to the upper part of the sigmoid flexure.

Eve's patient was a woman aged 63 years; she was admitted to St. Bartholomew's Hospital December 31, 1882. She had always been in good health until December 26, 1882, when at 10 A.M. she was suddenly seized with violent constricting pain around the abdomen in the region of the epigastrium, followed by violent vomiting and the passage of large loose stool. She had had slight attacks similar to this before, which were relieved by purgatives. On December 27 she passed a small movement with little blood and mucus. She continued to vomit all food from the beginning of the attack. The vomitus was at first bilious in character, later became brown, with fecal odor. On December 30, the temperature was subnormal; expression anxious; abdomen was uniformly but not tensely distended; there was incessant retching, but no vomiting. The rectum was free, an enema of warm water returned with some small fecal masses and blood-stained mucus. On January 22, after a consultation, Mr. T. Smith performed the operation for lumbar colotomy. A portion of the intestine was opened and much fecal matter evacuated. The condition gradually grew worse and on the morning of the twenty-fifth she went into collapse and died.

The conditions found in Eve's case are well shown in Fig. 2. The ascending colon took a course obliquely across the abdomen to the left hypochondrium, where it turned sharply to the right and followed the curve of the diaphragm until it reached the middle line; here it became suddenly bent upon itself and returned, above and parallel to its previous course to the lower edge of the spleen; thence it took the normal direction to the sigmoid flexure. Both the ascending and descending portions of the large intestine were closely united and almost surrounded by a single layer of peritoneum. Just above the cæcum, below the level of the hernial opening, there was a band of adhesions 1 inch in breadth and one-half inch in length, binding together the ascending colon and adjacent curve of the sigmoid flexure. Eve believes that this band of adhesions created conditions favorable to a hernia into the intersigmoid fossa.

The fossa itself is not so uncommon. Treves found a perfect fossa in 52 and a funnel-shaped depression in 13, or a total of 65 per cent. of the bodies examined. De Haen ("Ratio Medendi, Paris XI de Ileo Morbo," p. 103) quoted by Moynihan, describes a case of supposed hernia in the intestine through an opening in the mesosigmoidea. This has been referred to by Treitz, but the details are not sufficiently numerous to warrant Moynihan in regarding it as a case of true intersigmoid hernia.

Eve states that it would be useless to form rules for the diagnosis of this form of hernia which the next case would falsify. In both De Haen's and his own case the patient was periodically subject to abdominal pains associated first with constricting sensations and later tympanitis, indicating that the intestine not infrequently had slipped into the opening, but had been released by purgatives or naturally.

In 1895, ten years later, McAdam Eccles (St. Bartholomew's Hospital Reports, vol. xxxi) reports a case of strangulated hernia of a loop of small intestine in the fossa intersigmoidea.

The man, 53 years of age, was admitted to the West London Hospital under the care of Mr. Eccles on August 18, 1895, with well-marked symptoms of intestinal obstruction. He had for many years suffered from double inguinal hernia, both reducible and fairly well controlled by a truss. Four days before admission, while coughing, his left hernia came down and could not be reduced. He was taken to Cottage Hospital, near his residence, in which the surgeon with little delay and some difficulty reduced the hernia by taxis. The vomiting and pain, however, persisted. No fæces or flatus passed the rectum. On the fourth day he was admitted to the West London Hospital in the following condition: Facial expression anxious and typical of acute abdominal disturbance; pulse small and frequent; breathing thoracic; tongue furred; temperature 98.2°, abdomen evenly distended and everywhere resistant; no local swelling or induration could be made out. Under ether a median abdominal incision was made. High up in the iliac fossa in the posterior part of the abdomen was a firm resistant mass into which could be traced the small intestine, one part of which was distended, the other collapsed. Closer examination revealed a tightly constricting edge which afterward proved to be the margin of the aperture of the intersigmoid fossa. The sharp ring was carefully snipped with a pair of scissors and the gut slowly drawn out of its grasp. The loop of small intestine was then liberated. This was intensely congested, and black and gangrenous for a distance of about one-half inch in its middle. The whole loop measured about four inches. The gangrenous piece of bowel with the œdematous portion was excised with a V-shaped piece of mesentery and the ends united by Maunsell's method. The patient died of exhaustion 12 hours later. The record states that the post-mortem examination showed some general peritonitis, most marked in the region of the sigmoid flexure. The suture used in the anastomosis had held well. Nothing further is said about the condition of the intersigmoid fossa as disclosed by the autopsy.

Eccles states that this fossa was distinct in at least half of the subjects examined in the Rooms in 1894-1895, the per-

centage being 53. This corresponds very closely to the findings of Treves. Eccles states that in the fœtus this fossa is undeveloped. In Eccles' case the tightness of the strangulation was extreme, showing that once a loop of bowel becomes imprisoned, it is very seriously affected in a short time.

A careful reading of the history of Eccles' case must leave some doubt in one's mind whether this condition might not have been one of reduction *en masse* rather than a true hernia of the intersigmoid fossa. The history of a case of strangulated hernia, finally reduced under forcible and prolonged taxis, with a continuation of the symptoms of strangulation is absolutely typical of a case of reduction *en masse*. It does not seem at all probable that the same loop of strangulated bowel that had been reduced from the scrotum, could have been made to enter the intersigmoid fossa after reduction. It seems still more improbable that two loops of intestine could have been simultaneously strangulated, one in the intersigmoid fossa and one in the scrotum; and that when the latter was reduced, the former continued to give the same symptoms. It is reasonable to believe that one condition could have been easily mistaken for the other through the small incision used in the laparotomy, and the actual condition not recognized except by a very thorough autopsy, evidence of which is lacking in Eccles' case. He simply states that post-mortem examination showed some general peritonitis and that the sutures used in the anastomosis held well. There is no further description of the condition present in the fossa itself. (The case has, however, been accepted by Moynihan, the most competent authority.)

The third case of hernia of the intersigmoid fossa, is that of Lambret (*L'Echo Méd. du Nord,* 1897, p. 384). Lambret reports this case as the third known case of hernia of the intersigmoid fossa, stating that the two cases observed up to that time were the case of Jomini and that of Eve. Jomini's case (*Revue Médicale de la Suisse Romande,* 1882) was not accepted as a true case by Moynihan. Lambret describes his case as follows:

Male, aged 63 years, was admitted to the hospital with all the signs of acute intestinal obstruction which had lasted for a period of three days, coming on during an effort at defecation. The patient immediately had very severe pains in the abdomen without any particular localization; vomiting occurred soon afterward and finally became fecal. It ceased the day after his admission to the hospital; there was no passage of either gas or fæces; moderate abdominal obstruction; pulse rapid. Operation was immediately decided upon and it was performed by Folet. A median incision was made from the umbilicus downward. On opening the peritoneum,· a dilated intestinal coil was seen with other coils collapsed and embedded. The hand of the operator discovered in the upper part of the left iliac fossa a hard tumor, smooth, symmetrical—the nature of which it was difficult to determine. The withdrawal of the intestine was made very easily under the influence of light traction. A loop of intestine withdrawn was œdematous, purplish-red in color, but presenting no trace of constriction. The lumen of the intestine seemed permeable. The tumor perceived in the left iliac fossa at the beginning of the operation now disappeared. Reasoning from this fact, the hypothesis of a hernia in the intersigmoid fossa was advanced and the orifice of this fossa was quickly found; it was about as large as a five franc piece; its walls were infiltrated and dark-colored. The walls of the fossa were also of a purplish color and contained a certain quantity of bloody exudate. It had the appearance of a hollow sphere of sufficient size to hold a mandarin orange. The continuity of the bowel having been re-established, the operation was rapidly completed and the patient returned to his bed. No amelioration of the symptoms, however, followed. By the middle of the next day the patient had not passed any gas or fecal matter and his general condition was very bad. Another laparotomy was done and an artificial anus established. The intestine was, however, completely paralyzed, and the patient died during the night of septic peritonitis. Autopsy revealed nothing new, but enabled the removal of the anatomical specimen which is preserved in the surgical clinic of the St. Sauveur Hospital.

Jonnesco divides retroperitoneal hernia into four classes: (1) Herniæ through the foramen of Winslow. (2) Herniæ in the retroduodenal fossa. (3) Herniæ in the retrocæcal fossa. (4) Herniæ in the intersigmoid fossa..

The intersigmoid fossa has been carefully described by Toldt. Before the time of Toldt the intersigmoid fossa was believed to be situated between the two folds of the mesocolon of the sigmoid flexure,—while in reality, as shown by Toldt, this is very rarely the case, it being usually situated between the parietal peritoneum and the mesocolon. According to Lambret, the orifice of the fossa is best seen by lifting the

sigmoid flexure upwards and to the right to a level with the internal border of the psoas muscle, not far from the sacro-iliac synchondrosis and the bifurcation of the common iliac artery. In Lambret'*s case the falsiform fold was found over the orifice.

In the cases thus far observed, the cavity of the fossa has been of variable length, from 3 to 10 cm., in some cases reaching as far as the level of the pancreas. The shape of the cavity varied according to the intestinal contents, to which it always adapts itself. The origin of this fossa has been explained in various ways. Toldt and Jonnesco believe that it is dependent in a large measure upon the influence of the arteries of the mesosigmoid. Lambret believes that the intersigmoid fossa is the result of a particular mode of development of the peritoneum and the folds comprising the mesosigmoid. In brief, he believes that the fossa is due to an interruption in the process of fusion of the mesocolon, the fusion with the parietal peritoneum taking place at a point lower than normal. He believes that the fossa is present in about 80 per cent. of the cases, its protected situation being responsible for the very small number of herniæ that occur in this region.

II. INTRAPARIETAL VENTRAL HERNIA AT MCBURNEY'S POINT.

Mr. X., aged 53 years, had a left inguinal hernia since childhood. Four years ago, his horse fell during a polo match and rolled upon him, injuring the right side of his abdomen. Not very long after this he began to have pains in the region of the right iliac fossa which, it was thought, might be due to some trouble with the appendix.

I first saw the patient in consultation with Dr. W. L. Culbert of New York, in October, 1905. Physical examination at that time showed an oblique irreducible omental scrotal hernia on the left side, and on the right side a direct inguinal hernia about the size of an egg. No tenderness or resistance could be detected over the appendix, and it was believed that the pain and discomfort in the iliac fossa was probably due to the direct hernia which had not been hitherto discovered.

In the latter part of October, 1908, I operated for the double hernia, resected a portion of the omentum on the left side and found a direct hernia of the bladder on the right side. Both wounds were closed by Bassini's method; primary union followed and although the patient has led a very active life, riding and playing polo, there has been no recurrence up to the present time.

Immediately after his recovery from the operation, he stated that he felt the same pain and discomfort in the right iliac fossa in the region of McBurney's point that he had had before the operation. The trouble was always worse in the latter part of the day, after standing or being on his feet a good deal, and seemed to be relieved by pressure with the hand. I made a number of examinations, but was never able to detect any tenderness or other indications pointing to an inflammation of the vermiform appendix, although the patient localized his pain and discomfort exactly in the region of the appendix. The trouble gradually became more and more annoying and in November, 1908, I made another very careful examination. During this last examination I made the patient cough several times with my fingers pressing directly over the appendix and I then, for the first time, detected a swelling or tumor, apparently beneath the aponeurosis of the external oblique. On pressure the swelling disappeared with exactly the sensation that a hernial tumor gives when its contents slip back into the abdomen under pressure of the finger. The swelling could be made to reappear with the patient's coughing and gave the same sensation on deep pressure. The aponeurosis was apparently normal. Hence the most rational explanation of the phenomenon was that there was an opening through the transversalis fascia and internal oblique muscle of sufficient size to permit the hernial sac to protrude until it reached the aponeurosis of the external oblique. I, therefore, made the diagnosis of interstitial hernia at this point. This diagnosis explained perfectly the pain and discomfort which the patient had so long had in this region and also the gurgling sensations which he stated he had felt from time to time when pressing upon the abdomen in an effort to relieve the discomfort. I advised operation as soon as convenient to the patient. A consultation was first held with three other men. Two of these men were inclined to attribute the condition to intra-abdominal

adhesions, while the third thought it was due to a retroperitoneal lipoma rather than a hernia, but all advised operation. I operated upon the patient on January 27, 1909. Incision was made exactly as for an appendicitis operation. The aponeurosis of the external oblique was found intact and very firm. On cutting through the aponeurosis, a tumor about the size of a large goose egg was found. It was of yellowish color, and the outer layer, about one-fourth inch in thickness, consisted of extraperitoneal fat. On cutting through this, a hernial sac, the size of a large hen's egg, presented itself. This was opened and found to contain a loop of the cæcum, which immediately reentered the hernial sac as soon as it was reduced into the abdomen, showing that it had probably occupied this position most of the time, and when it became filled with gas or other contents, caused the pain and discomfort from which the patient had so long suffered. The neck of the sac was situated almost exactly at McBurney's point and the inner side touched the edge of the rectus muscle; it was about seven-eighths inch in diameter and was surrounded by a firm ring of transversalis fascia.

I believe that the hernia was probably of traumatic origin, that a rent in the transversalis fascia was caused four years before at the polo accident and that the hernial protrusion found its way through this shortly afterward, gradually making its way outward through the fibres of the external oblique muscle until its progress was finally checked by the strong layer of aponeurosis. It then enlarged in all directions until it formed a tumor of the size described. There were no adhesions between cæcum and sac. The sac was entirely removed and the transversalis layer and peritoneum sutured by overlapping. The internal oblique muscle was then closed with interrupted sutures of kangaroo tendon; next the aponeurosis and, finally, the skin.

The patient made an excellent recovery and left the hospital at the end of two weeks and has been perfectly well ever since. He has had no return whatever of any of the old symptoms. The size and anatomical position of the sac are well shown in Fig. 3.

The only case that I have been able to find at all similar to the foregoing is the case of Levy, recently reported in the *Beiträge f. klin. Chir.* In view of the fact that in Levy's case there was an undescended or partially descended testicle, there

FIG. 3.
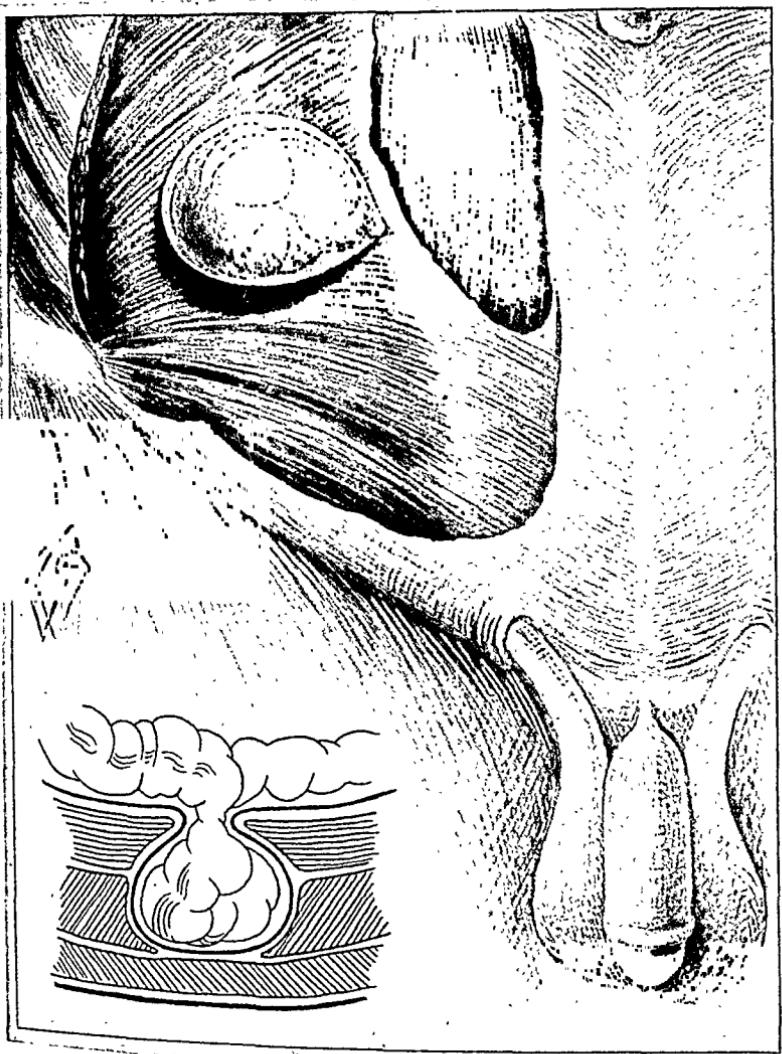
Interstitial hernia at McBurney's point. Sac containing cæcum. (Coley.)

is reason to believe that we have to deal here with one of the ordinary types of interstitial hernia with a bilocular sac, of congenital origin, entirely unlike the case I have described.

I disagree altogether with the statement of Levy that in the absence of complications the treatment of abdominal herniæ due to muscle defects should be mechanical, *i.e.*, that the patient should be fitted with a suitable abdominal support. I believe that all of these cases can be cured by a suitable operation without any risk to the patient. The fact that these cases are peculiarly liable to strangulation should be sufficient ground for advocating operative treatment as a routine measure.

CASE III.   RESECTION OF FOUR FEET OF SMALL INTESTINE FOR
RECURRENT ATTACKS OF INTESTINAL OBSTRUCTION FOL-
LOWING REDUCTION EN MASSE OF A STRANGULATED
HERNIA FOUR MONTHS BEFORE.

Mr. Y., 53 years of age; has always been in good health. Operated upon for strangulated hernia (by Dr. Foy of Yonkers) in January, 1909; duration of the strangulation 8 hours. A large loop of small intestine was found very dark in color, but as it partially recovered under hot towels was replaced in the abdomen. The patient did very well until three weeks after operation, when he had a slight attack of intestinal obstruction. Had five or six attacks since, sometimes every five or six days; he went one month without any attack; the last very severe attack occurred on May 8. These attacks always began by a localized distention in the left side, which gradually spreads upwards across the abdomen to the right iliac fossa. Vomiting quickly followed and persisted, becoming almost fecal in character. I saw the patient on May 10; he had a movement of the bowels due to strong pur-gatives and enemas. The abdomen returned to normal and nothing could be felt on palpation. The patient was somewhat weak from the effects of the attack. I believed the condition to be one of adhesions with constriction of the bowel and areas of sloughing. I advised an operation at as early a date as possible. The patient entered the hospital on May 12, 1909, and I did a

median laparotomy, assisted by Dr. W. E. Downes. I quickly found two separate loops of bowel joined at a sharp angle by a firm band of adhesions about 1 inch in diameter. These adhesions were cut and the raw surfaces turned in with silk suture. I then came upon a mass about the size of two fists, situated in the middle and a little to the right side of the abdomen; it consisted of five or six coils of small intestine so completely welded together that it was difficult in places to make out the outlines of the separate loops of intestine. It was evident that it would be impossible to separate these adhesions and I decided to resect the entire mass and do a lateral anastomosis. A piece of tape was passed through the mesentery and tied around the healthy portion of the bowel, well beyond the point to be divided. The mesentery was clamped off and sutured by means of fine chromicized catgut. The divided ends of the bowel were inverted and sutured in two layers. The portion removed extended nearly to the ileocæcal valve. A lateral anastomosis was made between the ileum and ascending colon by means of a large Murphy button. Inasmuch as the appendix was found to contain a large, very hard concretion and showed some evidence of congestion, it was removed. The abdominal wound was closed without drainage. Time of operation 1 hour, 15 minutes.

The first two days the patient was given a very small quantity of saline per rectum and a small quantity of water by mouth. On the third day he was given chicken broth and albumin water in one-half ounce portions every 2 hours. The amount of nourishment was gradually increased and at the end of the week he was given solid food. He had very little more reaction than follows an ordinary hernia operation. He passed the button on the eleventh day and was up and about the ward at the end of two weeks. The wound healed by primary union.

The condition of the intestine shows that at the time of reduction the bowel must have been reduced *en masse;* the adjacent loops were so much inflamed that they immediately became adherent and finally welded together in the solid mass seen by the mounted specimen presented.

VESICO-INTESTINAL FISTULÆ.*

BY FREDERICK W. PARHAM, M.D.,

AND

JOSEPH HUME, M.D.,

OF NEW ORLEANS, LA.

THE term enterovesical has been employed by many writers, but we have discarded it, because of hybrid Greek and Latin origin, and have adopted the etymologically more correct designation, vesico-intestinal fistulæ, as the title of this paper.

This is a comprehensive term, including all cases where a communication, direct or indirect, exists between the bladder and any portion of the intestinal lumen from pyloric orifice above to anus below. Appendiculovesical fistulæ have not been excluded from this consideration, but no thorough search of the literature has been made for this variety of communication. Some sixty odd cases are, perhaps, to be found scattered through the literature, many of which have not been available for the purpose of this communication. Some are so closely related to the cases under discussion that they have been utilized to illustrate certain phases of the subject.

The literature of vesico-intestinal fistulæ has been quite meager and, with the exception of a few articles, almost inaccessible to English readers. The materials for this paper have been drawn chiefly from Harrison Cripps, who wrote a monograph in 1888, based on 63 cases; Chavannaz, who published an excellent statistical study in 1897 of 95 cases; Kelly and MacCallum, on " Pneumaturia " in 1898; and Pascal, who published his " Doctorate Thesis " in 1900 on " Acquired Vesico-Intestinal Fistulæ," in which he brings the

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* Read before the American Surgical Association, June 5, 1909.

number up to 346 cases, including those of Cripps, Chavannaz and others collected from many sources. To these should be added the interesting case of Jewett's, referred to in Kelly and MacCallum's article.

We have searched the literature for cases appearing since 1900 and, as will be seen by the table appended, have added 38 cases, making the total 385 cases to date, including our own, a few conveyed in personal communication, and six cases found in an article by W. Sachs,* of Mullhausen, published in December, 1908.

From the earliest times there are occasional references to communications between intestine and bladder, but the condition was not at all carefully studied until about 1800. The first attempt at collecting and classifying the reported cases appears to have been made by Blanquinque in 1870.

The older writers considered the condition beyond the reach of the art and the first suggestion as to a rational treatment seems to have been made by Barbier de Melle, who, in 1843, believing the site of the fistula always to be in the cæcum, proposed colotomy as a means of cure. Pennell in 1850, and Curling in 1852, were the first to put this procedure into practice, but up to 1870 only six colostomies had been done for vesico-intestinal fistulæ. Pascal claims this as an essentially French operation, but admits that it obtained its greatest success in England.

In 1871 Simon operated on two cases of rectovesical fistulæ, sectioning the sphincter and making a direct suture of the rectal orifice; once with success. Billroth in the same year operated by the same method, but failed to relieve the patient. His observation was not published until 1879.

Dumenil, reporting a case before the French Surgical Congress at Rouen in 1884, highly extolled colostomy, and its popularization as a means of relief of this distressing malady is probably due largely to him.

These two operative principles combined—colostomy and later section of sphincter with suture of fistula—have since

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* Deutsche Ztschrft. f. Chir., Dec., 1908.

been the chief methods for attacking rectovesical fistulæ, until rather recent times.

Le Dentu, in 1884, before the Society of Surgery in Paris, suggested suprapubic cystotomy followed by intravesical suture of the bladder opening. This was carried out by Pousson in 1895, with temporary success but ultimate failure, and, as was to be expected, this plan has had few followers. Kelly and MacCallum in 1898, and Reginald Harrison in 1895, enumerate this among the surgical procedures, and one of us in 1897 in a case reported here did the same thing unsuccessfully.

In 1887, Czerny did the first laparotomy, but his patient died. The third and first successful one was done by Boiffin in 1891. Since then the principles of modern abdominal surgery have been freely utilized in such conditions. Cripps, however, writing in 1888 on a basis of 63 cases, takes a gloomy view of the prognosis and is in favor of colostomy rather than laparotomy—or rectal suture.

The best etiological classification seems to be:

Unknown

Traumatic
{ Accidental
{ Surgical

Non-Traumatic
{ Inflammatory, including { Abscess Stricture Stone Ulcer
{ Malignant
{ Tuberculosis
{ Syphilis
{ Actinomycosis

Many of the cases, especially the older ones, are so vague that the cause cannot be determined.

The traumatic fistulæ fall into two categories; accidental, by gunshot and stab wounds, falling on stakes, etc., of which the majority are caused by gunshot wounds; and surgical, following the lateral operation for stone, puncture of bladder by rectum, etc. Many such accidents must have followed surgical intervention in former days, but doubtless were not reported.

As a rule fistulæ due to traumatism are developed promptly, but in a minority of the cases they have followed secondarily, either owing to inflammatory action or to the irritation produced by a retained foreign body, bone, etc.

Again, spontaneous cure often follows traumatic fistulæ. Inflammation, cancer and tuberculosis are responsible for the greater number of non-traumatic fistulæ. Rarely one finds actinomycosis or syphilis as the cause.

Pascal, in his Thesis of 1900, gives the following table of non-traumatic cases, classified in this manner:

	Per cent.	No of cases
1. Origin in bladder, prostate, vesicles....	18	54
2. Origin in intestine....................	35	105
3 Origin in vicinity of bladder..........	16	48

It is impossible to do more than to give a general picture of the various changes met with at autopsy. The usual findings are those of chronic localized peritonitis, dense adhesions between intestines and intestines and bladder, and masses of indurated thickened tissue, in which may be found cavities containing pus and fæces; to which are added the special features of the causative agent—tuberculosis or neoplasm. Occasionally one finds a simple fistulous tract separating gut and bladder, or again a distinct purulent pouch, into which bladder and intestine empty—the "foyer intermédiare" of Chavannaz.

The bladder is usually contracted, very rarely dilated. Its inner surface, in addition to the abnormal orifice, presents the lesions of chronic cystitis with varied changes in mucous membrane and musculature. Pascal, under the influence of the French school, seems to think that cystitis is not constant, and secondary ascending infection rare. But from the history of the cases and those that we have seen, cystitis seems to be a constant concomitant in some degree, and out of 25 autopsies in which the condition of the kidneys was stated, 18 times they were diseased, and of these 15 were bilateral infections. Of these 18 cases, 6 were due to cancer, 3 to tuberculosis, and 9 to inflammatory processes. Kelly and

MacCallum state that renal symptoms are comparatively rare considering the state of the bladder.

The symptoms are naturally divided into those associated with the primitive lesion, and those dependent upon the fistulous condition. One is struck by the remarkable similarity in the clinical course of the collected cases. One follows another presenting practically the same phenomena, and only differing in causation and unimportant detail.

In the non-traumatic cases there is an antecedent history of intestinal or urinary disease, which ends either abruptly or insidiously by the passage of fecal matter and gas per urethram or liquid stools. As a generality the onset is insidious. Indeed, it is often a distinct surprise to the patient when he suddenly passes gas or fæces. Often the condition is only discovered accidentally, and rarely, though it has been so recorded, one is unaware of this condition.

Once the fistula established there is usually a period of calm, transient or prolonged, then vesical infection ensues and frequent, painful, perhaps, difficult, urination torment the unfortunate. With this there is much mental anxiety and perturbation; digestive troubles, malaise, deterioration in health progressively until the end which comes through general infection or the advancement of the original disease, be it carcinoma or tuberculosis.

Rarely, the patient experiences no discomfort, suffers no impairment of health and lives his life in spite of his condition.

When seen by the physician the prominent symptoms are the passage of gas or fæces per urethram, or liquid uriniferous stools and vesical or rectal disturbances: these suffice to characterize the malady.

It is impossible to read the monographs of Cripps, Chavannaz and Pascal, or to consider the outcome of the collected cases without realizing the gravity of this affection.

In 81 cases which Pascal anal-zed he found the mean duration of life, after the appearance of the fistula, to be three years. He also states that out of 300 cases only 19 recovered spontaneously, 15 recovered under expectant treatment, and 24 were cured by operative measures.

Fistulæ situated in the small intestine are unfavorable, as nutrition is interfered with. Those, whose orifices are guarded by papillæ or valves, offer a longer life, as the bladder is partially protected from constant inroads of fecal matter. The amount of disturbance depends largely upon the size of the communicating opening, small perforations oftentimes causing little discomfort. If the urine is passed per rectum rather than fæces per urethram the outlook is much better; and finally any obstruction to urination materially increases the danger as it favors renal infection.

Cancer and tuberculosis appear to be uniformly fatal, when causative agents of this condition.

The complications usually met with are of inflammatory origin or due to secondary calculus deposits in bladder.

While the prognosis is always serious, surgery offers a large hope that the future will see a greatly lessened mortality.

It would seem, at first glance, that the diagnosis of intestinovesical fistula would be easy, but in practice many cases are overlooked at first. The diagnosis to be complete must explain (1) the condition; (2) the cause; (3) the location of the fistula, (a) in bladder, (b) in intestine; (4) the mode of communication between the viscera, direct or indirect.

The differential diagnosis lies between (1) intestinovesical fistulæ; (2) uretero-intestinal fistulæ; (3) reno-intestinal fistulæ; (4) urethrorectal fistulæ; (5) pneumaturia.

In general, the passage of gas and fecal material by the urethra or liquid uriniferous stools, coupled with the finding of vegetable or animal tissue in the urine, complete the gross picture. Communication between the renal pelvis and intestine, or between ureter and intestine is to be made out by cystoscopic examination, showing (1) Absence of abnormal opening in bladder wall. (2) Seeing cloudy, and especially, fecal urine escaping from an ureteral orifice. (3) Catheterization of the ureters in every case of doubt. Segregation will be of use, but is unreliable, as an opening on one side of bladder might be confused with fecal flow into bladder through the ureter. The cause must be determined by the

history, physical examination, tuberculin reaction, examination of urine, etc. Confirmations may be had by the administration of bismuth or charcoal by mouth and their appearance in the urine.

A few words must be said on the question of gas passing per urethram. There are conditions, other than intestino-vesical fistulæ, in which this phenomenon occurs: (1) After instrumental vesical manipulation, litholapaxy, etc. (2) In certain neuropathic conditions. (3) In glycosuric conditions.* These excluded, the passage of gas through the urethra is pathognomonic.

In the bladder the perforation is usually single, occasionally double, very rarely multiple. It is usually small. The position varies, but in almost one-half the cases the abnormal orifice is formed on the base or posterior wall. The summit is the next most frequent position, and only exceptionally the anterior wall. But the location in the intestine is even more important and more difficult to decide on. The site of the opening determines to a great extent the operative measures for relief. Keen's case well illustrates the difficulties attending the definite location of the position of the fistula. The position of the fistula may be ascertained by (1) Cystoscopy. (2) Proctoscopy with digital exploration of rectum. (3) Introduction of plain, colored, or chemical solution or gases via bladder or rectum and their recovery from the opposite organ. (4) Character of food material in urine, as regards the stage of digestion. The elements of the food could be distinguished in Jewett's case indicating location near stomach, afterwards confirmed. By these means the gut can be explored as high as the sigmoid and the bladder in totality. If one is unable to locate the intestinal position of the fistula by these methods, there only remain conjecture and exploratory laparotomy.

* In Kelly and MacCallum's article on "Pneumaturia," this subject is very thoroughly discussed. Heurry Fenwick also considers it at some length in his work on "Clinical Cystoscopy." See also Dumenil, Rev. de Chir., p. 241; Guignard Jour. des mal. des org. gen., 1883, p. 242.

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Chavannaz gives the following percentages indicating the location of the fistulæ: Rectum, 44.44; sigmoid, 24.07; colon, 11.11; colon and ileum, 7.40; appendix, 1.85.

The treatment is either medical or surgical.

Medical: Including rectal and vesical irrigation, local treatment of fistula where possible by curettage and cauterization, urinary and intestinal antisepsis, specific medication, and all measures of general hygiene. Under such regime a certain proportion of cases have recovered; 36 out of 58 recoveries recorded by Pascal.

Surgical treatment may be either palliative or curative. The palliative measures are directed toward the amelioration of the distressing secondary symptoms resulting from stone, stricture, etc. While not designed to cure, this sometimes results in a relief of the condition. The extraction of a stone by lithotomy or lithotrity, the dilating of strictures in a few instances have been followed by healing of a fistula. Under this head may also be placed colostomy, intestino-anastomosis and lumbar transplantation of the ureters. When colostomy is decided upon it is necessary that it should be done so as to fulfil two conditions. First, it must be above the fistula; second, it must be complete, so as to have no connection between the upper and lower segments of the intestine. Moreover, the upper end of the lower segment must be left open and frequent irrigation through and through this segment must be practiced. Ballance lost two cases by closing the lower segment, and Madelung lost two cases where he closed the inferior end and dropped it into the cavity.

Intestino-anastomosis as first practiced by Boiffin and the procedure of Wassilief, or its modification suggested by Lardennois with the Murphy button might be considered in certain rare cases. This procedure of intestino-anastomosis has resulted in cure in a few cases. Intestinorectostomy, intraperitoneal, may be done 7 cm. above the sphincter.

Curative Treatment: Radical treatment has for its object separation of the abnormal openings between intestine and bladder and the restoration of their lumina by separate closure

of the openings. The operative approach may be made via (1) the rectum, (2) the perineum, (3) the sacrum, (4) the bladder, (5) the abdomen, or by combination of two or more of these methods. Rectovesical fistula situated within 4½ inches of the anal orifice may be best attacked by one of the perineal operations. This will usually be better than operating through the rectum. The operations of Marion Sims, Desault and others, through the rectum have given good results, and for certain fistulæ low down, are, perhaps to be preferred with, or without, section of the sphincter, primary or secondary. Perineal incision of Zuckerkandl is to be preferred to that of Simon as giving better access. If the suture is made in several layers, the last being of catgut, as suggested by Hugh Young, with suprapubic bladder drainage there will be good chance of success. The anterior transpelvic procedures of Langenbeck, Niehans and Helferich, Ollier and Chalot, are exceptional and will scarcely ever be necessary for closure of these fistulæ. Posterior transpelvic, or sacral operations, however, must be seriously considered in some of these rectovesical fistulæ situated too high for the rectoperineal operation. Of these we should give the preference to the osteoplastic resection. Where more than the coccyx is to be removed the best type of this operation is the Rehn-Rydigier. The transvesical, or intravesical operation suggested by Le Dentu is hardly to be recommended. Only one case, that of Duplay, Case 332, was successful. In one of the cases reported by us it was tried with only temporary success. In another case, that of Fowler, (Case 316), the bladder was merely opened suprapubically and drained, but no attempt was made to suture the fistulous opening in the bladder. Cure followed this simple procedure. All the others, Cases 304, 310, 329, 333, 334, 335, and our own, 378, were either absolute failures or only temporary successes.

Finally the intraperitoneal or transperitoneal operations are to be considered. One of these procedures is to be recommended in all cases where the milder operations have been either tried or are clearly inapplicable. Exploratory laparotomy often affords the only reliable means of informing one's

self thoroughly as to the true condition and its cause, and enables the surgeon to decide upon the best procedure from actual observation. Then, too, if nothing can be done, it may be easily terminated by the palliative operation of colostomy. If the point of adhesion or communication can be found and separated, the radical operation is the procedure of choice. In some cases it may be advisable to close only the intestinal opening, draining the intermediary pouch, or sometimes a simple drain may be put in, without closure of either opening. One case is reported cured in this way. (Terrier, Case 301.) If the adhesions are such as to make it impracticable to separate the viscera, the radical operation may have to be abandoned and intestino-anastomosis, or bilateral exclusion of the involved intestinal loop, or colostomy done as a last resort.

Sachs, in *Deutsche Zeitschrift für Chir.*, December, 1908, reports a case in which he successfully operated by excluding totally the portion of involved intestine, 15 cm. in length, turning in both ends of this, and re-establishing the intestinal continuity by end-to-end approximation with Murphy button. This procedure, the suggestion of which he credits to Salzer* has been carried out in only one other case, that of Eiselsberg (Case 384) which died five days after operation. While so brilliantly successful as in Sachs' case, it nevertheless is open to such serious objection that we must agree with Payr in asking yet more light upon the later course of cases so treated, before we can give it our unreserved endorsement. It is true that cases like those of Bryant and Harrison, in which autopsy some years subsequent to a colostomy for rectovesical fistula showed complete obliteration of all that part below the artificial anus, afford justification for the operation of complete intestinal exclusion as done by Sachs, but, as he points out, we cannot always be sure that urine or natural secretion in the excluded section may not accumulate and furnish a positive menace to life. Where the communication is with the lower part of colon, sigmoid or rectum, the flow of urine into the bowel is made evident by its escape from the anus;

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* "Festschrift Billroth," p. 536.

in such cases one would hesitate to resort to this operation of complete intestinal exclusion. Further, in cases of high intestinal involvement one may never be sure that there is no flow of urine from bladder to intestine, because even where it does occur it may be absorbed or be so mixed with fæces as not to be apparent in the stools. It would seem, then, until further investigation is made, that complete intestinal exclusion should only be carried out in those cases where we may be reasonably sure that the flow is only in the direction of the bladder, not from it into intestine. We think, with Sachs, that this problem calls for experimental investigation in animals to determine in how far bilateral, or complete, intestinal exclusion may be considered a safe surgical procedure.

CONCLUSIONS:

1. Establish clearly the nature of the lesion.

2. Determine the location of the opening in the bladder and in the intestine, when possible; this can usually be done by the modern methods of exploration of the rectum and bladder, and by a study of the intestinal contents passed per urethram.

3. Medical treatment is always to be tried for a reasonable time, as some cases have recovered under such management, and certain fistulæ of syphilitic origin have been absolutely cured by appropriate treatment.

4. The prognosis of cases untreated is generally bad and spontaneous cures are rare.

5. Ascending infection of the kidneys is one of the most important sequellæ, and this is always to be feared in cases that do not recover within a reasonable time.

6. Colostomy relieves the symptoms though it does not cure the condition, but is to be tried in all cases where a radical procedure is not possible.

7. Radical operation is always to be preferred when practicable; from below, when the fistula is situated within 4½ inches of the sphincter in suitable cases; intraperitoneally, for high-placed fistulæ, the viscera being separated and direct suture of each opening done.

8. Where the radical operation cannot be done, bilateral

or total exclusion of the portion of intestine involved, as practiced by Sachs in Case 385, may be done when there is no urinary flow into the bowel; this not being advisable, one of the shunting anastomosis procedures should be done, or simple drainage of an intermediary pouch resorted to.

9. The suprapubic intravesical suture of the bladder orifice is not to be recommended, because difficult of execution and uncertain in result.

10. Exploratory laparotomy is indicated in all cases in doubt to determine the location of the fistula and the operation of choice. Colostomy is to be regarded as an operation of last resort and applicable only in those cases where the artificial anus may with certainty be placed above the fistulous communication with the bladder.

DR. PARHAM'S CASE OF *Vesicorectal Fistula*.

J. L., 48 years of age, a native of Louisiana, consulted me in 1895, complaining of great irritability of bladder due to the passing of fecal matter.

Family history: Father died of pneumonia at the age of 52, mother died at age of 27, shortly after his birth. Both grandfathers died about the age of 60. Does not know anything of grandmother. One sister and two brothers are living and in good health, one half brother by father died of lung trouble at age of 36, one sister died at 52 years of heart trouble, two half sisters of yellow fever.

Personal history: Has been much afflicted with fevers since childhood, periodical in character. In 1889 had severe jaundice with stomach trouble. Had measles and whooping cough when a child. No history of chronic cough. Twenty-five years ago had severe dysentery lasting a month.

History of present disease: In October, 1892, suffered with constipation and pains in lower part of abdomen on left side, accompanied by frequent micturition, followed after each urination by burning sensation in the urethra. This continued about three weeks, when he took 10 grains of calomel followed by Epsom salts. Violent pains in lower abdomen attended the purgative action. In November, 1892, being still much troubled, he came to New Orleans and was treated by Dr. Chassaignac for two months. He thinks he passed some bowel contents occa-

sionally by urethra during this time, attended by much bladder disturbance. He went home much improved. Four months later he was so much better he was able to resume his duties as road and levee inspector in his country district, although he would have at times more or less bowel and bladder disturbance.

In November, 1893, he had an attack of dysentery, and was much worse with his urinary troubles. He came to New Orleans and was again under Dr. Chassaignac's care for three weeks. Under this treatment he improved and was well as before. He thinks he passed occasionally some fecal matter. After this, he continued to improve, the symptoms all disappearing except the frequent urination. He got much stronger and would have considered himself well, but for the occasional pains in the lower abdomen on the left side. He seems to have remained well for a long time after this, but in June, 1895, he became ill again with fever, colic in the lower abdomen, left side especially, followed some hours later by the passage of gas and fecal matter per urethram. He entered the Charity Hospital and was treated by Dr. Brickell for four weeks. Under treatment he improved very much. He would frequently urinate fecal matter. During constipation he would not pass fecal matter by urine for sometimes three or four days. He went home in June, 1895. In November, the symptoms of his old malady returned in aggravated form, preceded by diarrhœa. Fecal matter came now in increased quantity with the urine. This condition of things continued until his admission to my service at the Charity Hospital on November 18, 1895. His condition at this time was as follows:

Has lost much flesh, though not emaciated. General appearance good, complexion clear with slight conjunctival injection and some jaundice. Tongue fissured and slightly coated. Has good appetite and would sleep well were he not disturbed by frequent urination. Temperature, pulse and respiration normal.

Examination of abdomen, rectum and urinary organs: Somewhat constipated but consistence of passages normal. Has had no diarrhœa since his admission. Belly-wall loose and not retracted. Nothing revealed by palpation, except slight tenderness over region of bladder. In left inguinal region nothing, but in right inguinal region a reducible scrotal hernia. On standing right side of scrotum filled well with the descended bowel.

History of this hernia: Has been present as long as he can

recollect. Always suffered more or less, but never wore a truss until 1883, when one gave him considerable relief. In November, 1893, the truss being old had to be drawn very tight, but he is not sure that this had anything to do with the pains which came on in the lower abdomen.

November 30, 1895: Filled bladder with sterilized fuchsin solution; none came into rectum. Then emptied bladder and filled with uncolored fluid and threw methyl blue solution into rectum and allowed the bladder to empty through a catheter introduced, the patient being in knee-elbow position. No bluish coloring of the water was observed. Digital examination of rectum revealed moderately enlarged prostate, tender. Several hours afterwards a chill followed by fever to 103 degrees.

December 6: Is passing fecal matter freely, fecal odor, no undigested particles. Bowels have been somewhat disturbed during the night.

December 29: Assisted by Drs. Chassaignac, Matas, Martin and Delaup, I opened the abdomen in the middle line below the umbilicus. The upper part of the rectum and lower part of the sigmoid was adherent on the bladder wall. A large, hard mass could be felt here. We concluded it was an inoperable neoplasm and closed the abdomen.

January 13, 1896: Fecal matter is passing in increased quantity.

February 4, 1896: The condition being aggravated and radical operation being out of the question, I did an inguinal colostomy in two stages, the second stage being completed by the formation of the artificial anus three days later. The section of bowel was complete.

February 9, 1896: The stitches were all removed and the anus was well established. The lower segment of bowel was irrigated daily. Amelioration of the bladder symptoms was prompt and decided.

February 17, 1898: I determined now to make an effort to close the bladder opening and, if successful, to restore the continuity of bowel, where broken by the artificial anus.

Accordingly, on February 17, 1898, at the New Orleans Sanitarium, I opened the bladder above the pubic symphysis. I found the opening without much difficulty on the superior wall and sutured it with catgut, inserting four sutures. Dawbarn's intermittent siphonage was employed to protect the line of suturing.

(In another case I should use a de Pezzer catheter per urethram.) For a time it seemed that we would succeed, but the sutures gave way and the opening became re-established. The supra-pubic wound gradually healed and he was allowed to go back to his home in the country, no further effort being made to close the bladder fistula.

I have not seen him now for many years but have occasional letters from him. He wrote me during May of last year, report-ing himself as comfortable and enjoying good health. The artificial anus is easily managed, giving him little inconvenience except when bowels are loose.*

DR. HUME'S CASE. Mr. H. H., M. W., aged 39 years, mar-ried; has 5 children. Jan. 22, 1908: complaint, pus in urine and bladder trouble.

Family history: Two uncles, paternal, died of T. B. Past history: Mumps as a child, no orchitis. Malaria, no hæmaturia with it. Some inflammation of bowels 10 years ago. Does not know what it was; some thought it appendicitis; was in bed one month. General health good; constipated; average weight 153 pounds; 8 to 10 pounds below it now. Venereal history. Soft sore 20 years ago; no secondaries. Denies gonorrhœa.

Present illness: Patient well till one year ago. Then, when in a malarial attack, his urine was examined and pus was found in it, also albumin. Since then seen by several doctors who con-sidered he had kidney trouble, probably tuberculosis. Patient has no symptoms save from frequency of urination and a " sput-tering," as if air was in his urine, on urination. Every two to four weeks he gets depressed, feels drowsy, occasionally has chill with fever. Has pain in back low down in middle of spine. He is then sick with fever for a few days, and his urine seems worse at such times. He has had these attacks for twenty years, five or six a year at first, later every two to six weeks. Duration one to eight days. Considered as malarial or bilious attacks and treated by purging.

Examination.—Patient, well-built male; prematurely gray and aged to eye. Tongue furred. Thorax negative, abdomen negative save for slight pain in (1) left iliac fossa, (2) right

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*It is not infrequently true that a mass suspected after abdomen is open to be malignant, is proven, as in this case, by the lapse of time to be merely inflammatory infiltration (see also Mayo's article on Diverticulitis).

TABLE OF CASES

x r = Urine by rectum.
f x u = Fæces by urethra.
rf = Either or both ways.
F. I. = Foyce intermédiare.
A. = Autopsy.
2 I = Two orifices in intestine.
2 B = Two orifices in bladder.

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
1	M	Cancer of rectum	Rectum and bladder-neck. 1	u x r		Autopsy	12 yrs.
2	M			f x u			
3	M 12	Cancer of bladder	Rectum and bladder. 1	u x r		Recovery	
4	M 80	Traumatic		f x u	Medical	Death	3 mos.
5	F	Cutting for stone	Rectum and bladder. 1	u x r	Medical		
6	M 50			u x r		A., cancer of Bladder	
7	M			u x u		Recovery	
8	M			f x u		A., ulceration of bladder	
9	M			u x r		A., cancer of bladder-neck	
10	M	Stone (?)	Bladder and rectum	u x r		A., ulceration found	
11	M	Gonorrhœa (?)		f x u			
12	M 50	Stone	Rectum and bladder	u x r	Medical	Failure	
13	M			f x u		Death	6 mos.
14	M		Colon and bladder	f x u		A., abscess in left iliac fossa	
15	M 60	Stone	(Kidneys diseased)	f x u		Autopsy	
16	M 7	Traumatic		u x r	Medical	Recovery	
17	M 69	Stone	Rectum and bladder	u x r	Medical	Death	
18	M 50	Cancer (?)		u x r		A., rectum not examined	
19	M	Ulceration	Rectum and bladder	u x r		Death	
20	M			u x r			
21	M			f x u		Death	
22	M 50			u x r		Death	

No.	Sex & Age	Cause	Fistula	f x u	Medical	Result	Duration
23	M 73	Stricture of sigmoid	Colon and bladder (Kidneys diseased.) F.I.	f x u	Medical	Autopsy	....
24	F	Cancer (?)	Colon and bladder	rf		Death	3 mos.
25	M 60	Stone (?)	Colon and bladder	f x u		Autopsy	8 mos.
26	M 63	Ulcer of rectum		u x r		Recovery (?)	....
27	M 62	Stricture (?)	Ileum and bladder	f x u		Autopsy	1 mo.
28	M 60	Traumatic. Puncture of bladder by rectum	Rectum and bladder	u x r			10 yrs.
29							
30	M	Traumatic. Puncture of bladder by rectum		u x r		A., Suppurated	11 da.
31	M 50	Stricture of rectum		f x u		Death	5 mos.
32	M 50	Abscess between bladder and rectum		f x u	Medical	Recovery	....
33	F 24	Inflammation	Sigmoid and bladder. F.I.	f x u		Autopsy	1 mo.
34	M 6	Cutting for stone		u x r		Not cured	6 da.
35	M 14	Cutting for stone		u x r		Death, peritonitis	30 da.
36	M 16	Gun shot. Traumatic	Rectum and bladder	u x r			....
37	M 60	Cancer (?)	Colon and bladder	f x u		Autopsy	5 mos.
38	F 59	Stricture	Sigmoid and bladder	f x u		Autopsy	....
39	M 53	Inflammatory	Rectum and bladder	u x r		Autopsy	1 mo.
40	M 76	Inflammatory	Sigmoid and bladder F.I.	rf		Autopsy	
41	F 27	Child-birth. Inflammatory	Rectum and bladder	f x u		Autopsy	3 mos.
42	F 19	Child-birth	Rectum and bladder	f x u			....
43	M	Tubercular (?)	Colon and bladder. F.I.	f x u		Autopsy	2½ mos
44	M 60	Cancer	Colon and bladder	f x u		Autopsy	4 yrs.
45	M 60	Inflammatory	Rectum and bladder	u x r	Medical	Recovery, cured	2 mos.
46	F	Cancer	Rectum and bladder	f x u		Autopsy	....
47			Rectum and bladder	f x u			....
48	M 65	Stone	Rectum and bladder				....
49		Cancer	Sigmoid and bladder	f x u		Death	....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
50	M 7	Stone (?)	Ap. and bladder. 2B. (Kidneys diseased).	f x u		Death	8 mos.
51	F 65	Cancer	Ileum and bladder	f x u		Death	4 yrs.
52	F 42	Syphilis	Rectum and bladder	u x r		Autopsy	
53	Child		Rectum and bladder	u x r			
54		Stricture	Rectum and bladder	f x u			
55	F 68	Ileum and bladder		f x u	Colotomy	Lived 5 months	
56	M 62	Stricture	Colon, rectum, ileum, and bladder	f x u		Death	
57				f x u		Autopsy	
58		Stricture of sigmoid	Colon and bladder			Autopsy	
59	M 38	Traumatic	Rectum and bladder	f x u	Medical	Autopsy	17 da.
60	M 50	Puncture of bladder	Rectum and bladder	u x r	Medical	Improvement	
61	M 64	Traumatic	Jejunum and bladder (Kidneys diseased?)			Autopsy	
62		Abscess	Rectum and bladder	f x u			
63	F 23					Death	
64	F	Abscess of ovary (?)	Sigmoid and bladder. F.I. (Stone in kidney.)			Death	
65	F 35	Inflammatory	Appendix, cæcum and bladder. F.I.	f x u		Autopsy	
66	M 40	Inflammatory	Colon and bladder	f x u			6 mos.
67	F		Colon and bladder. 2 I. F.I.			Autopsy	3 wks.
68	F 54		Bladder, sigmoid and ileum	rf		Autopsy	3 yrs.
69	F	Child-birth	Rectum and bladder	f x u		Autopsy	
70		Cancer of cæcum	Cæcum and bladder			Autopsy	
71		Tuberculosis (?)	Sigmoid and bladder	f x u		Autopsy	

72	M	Inflammatory	Rectum and bladder (Kidneys diseased.)				
73	M 25	Stricture of rectum	Rectum and bladder	f x u	Autopsy		2 yrs.
74	F 45			f x u	Improved		
75	M 64	Stricture of sigmoid	Sigmoid in bladder	f x u	Improved		
76	M	Stone (?)		rf	Death		
77	M	Urethral stricture			Improved		
78	M	Stricture of urethra (?)		f x u			
79	M 79			f x u	Death		1 mo.
80	M 44	T. B. of prostate and stricture of urethra	Rectum and bladder. 2 B. (Kidneys diseased)	u x r	Autopsy		
81	F 18	Inflammatory	Cæcum and bladder. F.I.	f x u	Autopsy		
82	M 37			f x u			
83	M 33	Tuberculosis		f x u	Death		
84	M 56	Stricture of sigmoid	Sigmoid and bladder. F.I	f x u	Autopsy after operation	operation, colotomy	17 da.
85	F	Inflammatory		f x u	Recovery		
86	33	Tuberculosis (?)		f x u			
87	59	Abscess	Large intestine and bladder	f x u	Autopsy		
88	F 20		Ileum and bladder. (Kidneys congested)	u x r	Recovery		
89	F 43	Abscess		f x u	Autopsy		2 mos.
90	56		Rectum and bladder	f x u	Death		5 mos.
91	M 35			f x u	Death		14 yrs.
92					Death		
93	54	Cancer of rectum	Rectum and bladder	f x u	Autopsy		2 wks.
94	M	Tuberculosis	Cæcum and bladder. 2B.	f x u	Autopsy		6 wks.
95	M old	Obstruction		f x u	Death		
96	F 48	Inflammatory and tubercular	Cæcum and bladder. F. I. (Right kidney diseased.)	f x u	Autopsy		22 yrs.
97	F 28	Cancer (?)	Large intestine and bladder	rf			

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
98	M 43	Abscess	Cæcum, ileum and bladder. F. I	f x u	....	Autopsy	....
99	M 60	....	....	f x u	....	Autopsy	....
100	M 42	Syphilis (?)	Appendix and bladder	....	....	....	....
101	M 3½	Cutting for stone	Rectum and bladder	....	....	....	10 da.
102	M	....	....	f x u	....	Recovery	....
103	F	....	....	....	....	....	....
104	F	....	....	f x u	....	....	....
105		....	....	f x u	....	....	....
106	M	Inflammatory	....	f x u	....	....	....
107	(This	number omitted in	Pascal)	....	No case	Recovery	....
108	F 57	Inflammatory	....	f x u	....	....	12 da.
109	F 15	Tuberculosis	....	f x u	....	....	....
110	35	Obstruction	....	f x u	....	Death	....
111		Abscess	....	f x u	....	Death	....
112	M 32	Abscess of prostate; tuberculosis	Rectum and bladder. (Kidneys diseased)	rf	....	Death / Death / Autopsy	....
113	F	Cancer of rectum	Large intestine and bladder	u x f	Operation, colotomy	Death	....
114	M 85	Ulceration of rectum	....	f x u	Operation, colotomy	Death	....
115	M 51	Ulceration	Sigmoid, cæcum and bladder	rf	Operation, colotomy	Autopsy	....
116	M 55	Cancer of bladder	Rectum and bladder	rf	....	Autopsy	....
117	M 37			f x u			
118	M 8	Inflammatory	Appendix and bladder. F. I	u x r	Operation for stone	Autopsy	....
119	F	Inflammatory	Bladder and intestine and skin	....	....	Autopsy	....
120	M 35	....	....	u x r	....	Death	....

No.	Sex/Age	Disease	Location	f x u	Treatment	Result	Time
121	M 44	Tuberculosis	Cæcum and bladder. F.I.	f x u		Autopsy	7 mos.
122	....	Rectal ulceration	Rectum and bladder	u x r	Bougie	Improvement	....
123	....	....	Rectum and bladder			Autopsy	....
124	F	T. B. or Lues	Rectum and bladder. F. I. 2 R (Kidney diseased)			....	....
125	M 40	Inflammation	Rectum and bladder	f x u	Local	Recovery	26 yrs. after
126	M	Inflammatory	Colon and bladder	f x u	Suture of fistulæ by rectum	Suicide; autopsy	....
127	F 41	Cancer of uterus	Rectum and bladder. F. I.			Autopsy	....
128	F 69	Cancer of uterus	Rectum and bladder			Autopsy	....
129	F 63	Cancer of uterus	Rectum and bladder			Autopsy	....
130	F 45	Cancer of uterus	Rectum and bladder			Autopsy	....
131	F 59	Cancer of uterus	Rectum and bladder			Autopsy	....
132	F 52	Cancer of uterus	Rectum and bladder. (Right kidney, cancer)			Autopsy	....
133	F 43	Cancer of uterus	Rectum and bladder			Autopsy	....
134	M 62	Cancer of rectum	Rectum and bladder			Autopsy	....
135	M 61	Cancer of bladder	Rectum and bladder			Autopsy	....
136	M 60	Rectal stricture	Rectum and bladder		Colotomy	Death	....
137	M 60	Rectal ulceration	Rectum and bladder		Colotomy	Death	....
138	M 59	Ulceration	Sigmoid and bladder	rf	Colotomy	Death	....
139	M 20	Stricture of rectum	Rectum and bladder		Colotomy	Improvement	....
140	M	....	Colon and bladder	f x u		Autopsy	....
141	M 70	....	....	f x u		Death	....
142	M 65	....	Colon and bladder. F.I. (Kidneys diseased.)	u x r		Autopsy	....
143	M 44	Inflammatory	Rectum and bladder	f x u	Operation for stone	Improvement	....
144	M 44	Traumatic	Rectum and bladder	u x r	Colotomy	Death	....
145	M 54	Cancer of rectum	Rectum and bladder	rf		Death in 6 weeks	....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
146	M 55	Traumatic; rectal puncture	Rectum and bladder	u x r	External urethra	Improvement	....
147	M 60	Inflammatory (?)	Colon and bladder	f x u		Autopsy	....
148	M	Tubercular	Rectum and bladder	.....	Operation	Autopsy	....
149	M	Traumatic	Rectum and bladder. 4 B. F. I.	u x r	Operation for stone	Autopsy	....
150	M 30	Traumatic. Bullet wound	Rectum and bladder			Autopsy	....
151	M						....
152	M 72		Colon and bladder	f x u		Improved	....
153	M	Traumatic	Colon and bladder				....
154	M 25			f x u			....
155	M 49	Rectum ulceration	Rectum and bladder	f x u	Colotomy	Death	....
156	F 55	Inflammation	Rectum and bladder	f x u		Recovery	....
157	F 23	Pelvic abscess	Rectum and bladder	f x u	Opening of abscess	Recovery	....
158	F	Ovarian abscess	Sigmoid and bladder. F. I.	f x u		Death	4 yrs.
				f x u		Autopsy	1 yr.
159	M	Gunshot wound	Rectum and bladder	.....	Division of sphincter	Recovery	....
160	F	Child-birth	Rectum and bladder				....
161	M 27	Gunshot wound	Rectum and bladder	u x r	Catheter	Improvement	....
162	M 40	Traumatic	Rectum and bladder	u x r	Medical	Recovery	....
163	M 27	Tuberculosis (?)	Rectum and bladder	rf	Colotomy	Death in 3 weeks	....
164	M 52	Inflammatory	Colon and bladder	f x u		Autopsy	....
165	M 58	Cancer of rectum	Rectum and bladder	rf	Colotomy	Death	....
166	M 60?	Cancer of rectum	Rectum and bladder	f x u	Colotomy	Death	....
167	F	Child-birth	Rectum and bladder	rf	Colotomy	Recovery	....
168				f x u		Death	....
169			Colon and bladder	f x u		Autopsy	....

No.	Age	Cause	Location		Treatment	Result	Duration
170	F 76	Child-birth	Cancer of sigmoid	....	....	Autopsy	....
171	M 50	Inflammatory stricture of rectum	Rectum and bladder F. I.	f x u	....	Autopsy	....
172		....	Rectum and bladder. F. I.	f x u	....	Autopsy	....
173	M 60	....	Colon and bladder	f x u	....	Death	....
174	M 58	Cancer of colon	Colon and bladder. (Kidneys diseased)	f x u	....	Autopsy	....
176	M 67	Stricture	Sigmoid and bladder. 2 B. F. I.	f x u	....	Autopsy	....
177	M 16	Traumatic	Rectum and bladder	u x r	Medical	Recovery	....
178	M 46	Traumatic	Rectum and bladder	....	Medical	Recovery	....
179	M	Traumatic	Rectum and bladder	f x u	Catheter	Recovery	....
180	M	Traumatic	Rectum and bladder	....	....	Recovery	....
181	M 55	Traumatic	Rectum and bladder	....	....	Recovery	....
182	M	Traumatic	Rectum and bladder	....	Operation for secondary stone	Recovery	....
183	M	Gunshot wound	Rectum and bladder	....	....	Recovery	....
184	M	Gunshot wound	Rectum and bladder	....	....	Recovery	....
185	M	Gunshot wound	Rectum and bladder	....	....	Recovery	....
186	M	Gunshot wound	Rectum and bladder	....	....	Recovery	....
187	M	Gunshot wound	Rectum and bladder	....	....	Recovery	....
188	M	Gunshot wound	Rectum and bladder	....	Catheter	Recovery	....
189	M	Gunshot wound	Rectum and bladder	....	....	Recovery	....
190	M	Gunshot wound	Rectum and bladder	....	....	Recovery	....
191	M	Gunshot wound	Rectum and bladder	....	....	Fistula persisted	....
192	M 23	Gunshot wound	Rectum and bladder	....	Secondary operation for stone	Recovery	....
193	M	Gunshot wound	Rectum and bladder	....	Catheter	Recovery	....
194	M 26	Gunshot wound	Rectum and bladder	....	....	Recovery	....
195	M 35	Gunshot wound	Rectum and bladder	....	....	Recovery	....
196	M	Gunshot wound	Rectum and bladder	....	....	Fistula persisted. Death	13 mos.
197	M 34	Gunshot wound	Rectum and bladder	....	....	Recovery	....
198		Gunshot wound	Rectum and bladder	....	Secondary operation for stone	Fistula persisted	....
199	M 30	Gunshot wound	Rectum and bladder	....	....	Fistula persisted	8 yrs.

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
200	M	Gunshot wound	Rectum and bladder			Fistula persisted	
201	M	Gunshot wound	Rectum and bladder			Recovery	
202	M	Gunshot wound	Rectum and bladder			Recovery	
203	M 29	Gunshot wound	Rectum and bladder		Secondary operation for stone	Recovery	
204	M	Gunshot wound	Rectum and bladder			Recovery	
205	M	Gunshot wound	Rectum and bladder			Death	
206	M	Gunshot wound	Rectum and bladder			Death	
207	M 27	Gunshot wound	Rectum and bladder	u x r		Recovery	27 dn.
208	M 22	Gunshot wound	Rectum and bladder			Fistula persisted	
209	M 39	Gunshot wound	Rectum and bladder			Fistula persisted	
210	F	Gunshot wound	Rectum and bladder			Autopsy	
211	M 23	Traumatic	Jejunum and bladder			Recovery	
212	M 26	Tuberculosis	Large intestine and bladder. F. I. (Kidneys healthy).	rf	Secondary operation for stone	Autopsy	
213	F 52	Inflammatory	Duodenum and bladder	f x u			
214	M	Operation for stone	Rectum and bladder. (Bright's disease)	u x r	Cauterization of bladder orifice	Recovery	
215		Inflammation (?)	Rectum and bladder	f x u	Division of sphincter twice	Death	
216	M 70	Traumatic	Rectum and bladder	f x u		Autopsy	
217	M	Typhoid fever (?)	Colon and bladder	f x u			
218	M	T. B. (?)	Colon and bladder	f x u			
219				f x u			8 yrs.
220				f x u			
221	M	Cancer of prostate	Rectum and bladder	f x u			
222	M 28	Operation for stone		u x r		Recovery (?)	

No.	Sex/Age	Cause	Location		Operation		Result	Duration
223	M 53	Cancer of rectum	....	f x u	Colotomy	.....	Recovery	2½ yrs.
224	F	Inflammation following child-birth	Intestine and bladder. (Kidneys normal.) 2 B	f x u	.....	.....	Autopsy	.....
225	F 50	Stone	Colon and bladder	f x u	Operation	.....	Improvement	.....
226	F	Stone	....	rf	Operation	.....	Recovery	.....
227	M 4	Sarcoma of ileum	Ileum and bladder	f x u	.....	.....	Autopsy	.....
228	F	Tumor of uterus	Colon and bladder	f x u	.....	.....	Death from T. B.	.....
229	F	Inflammatory	Large intestine and bladder	.....	.....	.....	.....	.....
230	M 27	Stricture of rectum	Large intestine and bladder	.....	Colotomy, rt.	.....	Autopsy 10th day	16 mos.
231	F	Child-birth	Rectum and bladder	f x u	.....	.....	Recovery	.....
232	F 25	Child-birth	....	f x u	Colotomy	.....	Death	.....
233	F 30	Inflammatory	Colon and bladder. F.I.	f x u	Colotomy	.....	Autopsy	.....
234	M 50	....	Rectum and bladder	f x u	Catheter; sphincter cut	.....	Improvement	.....
235	M	....	....	.....	.....	.....	.....	.....
236	M 69	Tuberculosis	Ileum and bladder	f x u	.....	.....	Autopsy	.....
237	M 85	Ulceration	Rectum and bladder	f x u	.....	.....	Autopsy	.....
238	.....	Cancer	Rectum and bladder	f x u	.....	.....	Autopsy	6-7 mos.
239	.....	Cancer	Rectum and bladder	.....	.....	.....	Autopsy	2 yrs.
240	.....	Cancer	Rectum and bladder	.....	.....	.....	Autopsy	.....
241	M 79	Inflammatory	Rectum and bladder	u x r	.....	.....	Autopsy	.....
242	.....	Cancer	Rectum and bladder	.....	.....	.....	Autopsy	.....
243	.....	Ulceration	Rectum and bladder	.....	.....	.....	Death. Specimen	.....
244	.....	.....	Rectum and bladder	.....	.....	.....	.....	.....
245	M 22	Traumatic	Rectum and bladder	rf	Operation, stone removed; suture	.....	Recovery	.....
246	.....	Operation for stone	Rectum, bladder and urethra	.....	.....	.....	.....	.....
247	.....	Operation for stone	Rectum, bladder and urethra	.....	.....	.....	.....	.....
248	.....	.....	Sigmoid and bladder. F.I. 2 B	.....	.....	.....	Autopsy	.....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
249		Ulceration	Rectum and bladder. 5 R			Autopsy	
250	M	Stricture of sigmoid	Colon and bladder	f x u		Autopsy	
251	M 33	Gunshot wound	Rectum and bladder	f x u			
252	M 23	Cancer of bladder	Colon and bladder	f x u		Autopsy	
253	M 44	Traumatic	Rectum and bladder	u x r	Sphincter cut	Improvement.	
254		Stricture of sigmoid	Rectum and bladder. (Kidneys diseased). 3 R	f x u	Sphincter cut; fistula explored	Autopsy	
255	M 52	Tuberculosis of prostate	Rectum and bladder. (Right kidney healthy left T. B.)	u x r		Autopsy	
256	M		Rectum and bladder				
257		Operation for stone			Operation	Not cured	
258	M 48	Traumatic			Operation	Recovery	
259		Inflammation	Colon and bladder. (Kidneys diseased)	f x u	Laparotomy; suture; colotomy	Recovery	
260	M	Stone	Rectum and bladder		Operation	Autopsy	
261	M 69	Cancer of prostate(?)	Rectum and bladder	f x u		Recovery with repeated cauterization	
262	M 50	Cancer of rectum		f x u	Colotomy	Death	
263	F 69			f x u		Death	
264	F 50	Cancer of rectum	Ileum, colon and bladder	f x u		Improvement	
265		Traumatic	Rectum and bladder	f x u	Sphincter cut, no catheter	Autopsy	
266	F 25	Inflammatory (?)		f x u	Medical	Recovery	
267	F	Perityphlitis			Operation	Improvement	
268		Sarcoma of bladder					
269	M 41	Appendicitis	Colon and bladder. F.I. (Kidneys normal.)	f x u	Operation	Autopsy	

			Rectum, bladder and vagina	u x r	Operation	Improved
270	F 23	Child-birth	Rectum, bladder and vagina			
271	F	Child-birth	Rectum, bladder and vagina	f x u	Colotomy	Autopsy 2 years later
272	F 36	Cancer of rectum	Rectum and bladder	f x u	Medical	Spontaneous cure in 5 months
273	F 36	Inflammatory	Sigmoid and bladder			Recovery
274	M 25	Syphilis	Large intestine and bladder	f x u	Hydrogen gas diagnosis	
275	F	Inflammatory	Rectum and bladder	rf	Colotomy	Autopsy. Death in 3 yrs
276	M 19			f x u		
277	M 28		Rectum and bladder	f x u		Autopsy
278	M 50		(Kidneys diseased)	f x u		
279	M 61		Colon and bladder	f x u		
280	M 60		Rectum and bladder	f x u	Colotomy	Great improvement
281	M 50		Sigmoid and bladder		Irrigation	
282	M adult		Rectum and bladder	rf		Cured
283			Sigmoid and bladder		Medical	
284	F 32	Syphilis and rectal stricture	Rectum and bladder	f x u	Laparotomy and colotomy	Death in 8 days
285	M	Inflammatory	Rectum and bladder			Autopsy
286	F 34	Stone and inflammation	Colon and bladder. F. I.		Vomited urine and faeces	Death
287	F	Peritonitis		u x r	Catheter and irrigation	Recovery
288	M	Gunshot wound			Sphincter cut and sutured; catheter	Autopsy
288	M 24	Gonorrhœa and inflammation	Rectum and bladder. (Kidneys diseased)			
289		Cancer	Intestine and bladder	f x u	Laparotomy	Recovery (?)
290	M 28	Appendicitis	Rectum and bladder			Death
291	F	Cancer of uterus	Bladder and ileum			

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Faeces	Treatment	Result	Duration
292	F 28	Inflammatory (?)	......	f x u	......	......	......
293	M 5 mo.	Operation for anal atresia	......	f x u	Operation	Recovery	......
294	F 33	Stricture of rectum	Rectum and bladder	rf	Proposed cystotomy refused	......	......
295	M 35	Cancer of intestine	Sigmoid and bladder	f x u	Laparotomy	Death in 4 days	......
296	M 50	Tuberculosis	Rectum and bladder. F.I	f x u	......	......	......
297	M 36	Cancer of sigmoid	Sigmoid and bladder. (Kidneys diseased)	f x u	Laparotomy	Autopsy	......
298	43	Inflammatory	Colon and bladder	f x u	......	Autopsy	......
299	17	Traumatic	......	u x r	......	Recovery	......
300	7	......	......	f x u	......	......	......
301	......	Inflammatory	......	f x u	Laparotomy, no suture. Simple drain	Recovery	......
302	M 27	Traumatic and gonorrhœa	Rectum and bladder. F.I.	rf	Ext. uret (2); sphincter cut; rectum sutured (3); cath. failed; rectum pulled down and attached to end of sacrum after resection of coccyx	Recovery	......
303	M 36	Traumatic and gonorrhœa	Rectum and bladder	u x r	Perineal dissection, sphincter cut; bladder drained	Recovery	......
304	M 29	Inflammatory	Colon and bladder	f x u	Cystoscope and operation, suprapubic suture of orifice	Improved	......

No.		Type	Location	Code	Treatment	Result	Remarks
305	F 43	Rectal stricture	Rectum and bladder	f x u	Colotomy; laparotomy; 2 yrs. later	Improved	....
306	F 17	Inflammatory	Appendix and bladder (?)	f x u	Cystoscope; laparotomy	Recovery	....
307	F	Typhoid fever	....	f x u	Medical	Death	....
308	F 62	Diverticula of Meckel	Ileum and bladder	f x u	Laparotomy	Recovery	....
309	M	T. B.	....	....	....	....	....
310	M 43	Cancer (?)	....	f x u	Laparotomy twice	Death	....
311	F 52	Cancer of sigmoid	Sigmoid and bladder	f x u	Laparotomy, resection and erroneous union	Autopsy	....
312	F 33	Postpuerperal inflammation	....	f x u	cystoscoped; orifice found	....	....
313	F 42	Fibroma	....	f x u	Hysterectomy; laparotomy	Great improvement	....
314	F 60	Inflammatory	Sigmoid and bladder	f x u	cystoscoped; laparotomy	Recovery	....
315	F 57	Inflammatory	Rectum and bladder	f x u	cystoscoped; orifice found; suture of orifice; laparotomy	Death	....
316	M 62	Appendicitis	Appendix and bladder. F.I.	f x u	Suprapubic stone removed	Improvement	....
317	M 25	Appendicitis	Appendix and bladder	f x u	Operations: (1) perineal section; (2) colotomy; (3) laparotomy; (4) colotomy closed	Rec. Death in 24 days from obstruction	....
318	F 40	Inflammatory	Ileum and bladder	f x u	Cystoscoped; orifice found; laparotomy	Recovery	....
319	M	Tuberculosis	Rectum and bladder	u x r	Irrigation	Cured	....
320		Inflammatory	Rectum and bladder	....	....	Autopsy. Abdom. fistula; great adhesions; numerous fistula	....
321	F 30	Actinomycosis	Rectum and bladder (Kidneys diseased)	f x u	....	....	....
322	F 32	Actinomycosis	Rectum and bladder	f x u	Medical	Autopsy	....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Faeces	Treatment	Result	Duration
323	M 35	Actinomycosis	Appendix and bladder. (Right ureter diseased)	....	....	Autopsy	....
324	M 34	Vesical tumor	Large intestine and bladder. (Kidneys diseased)	f x u	....	Autopsy	....
325	F 28	Inflammatory	Sigmoid and bladder. (Kidneys diseased)	f x u	Laparotomy; (2) cystotomy; colotomy	Improvement, then death	....
326	M 67	....	....	rf	Cystoscoped; orifice found	Death 2 years later	....
327	F 42	....	Rectum and bladder	rf	suprapubic; stone removed	No change	....
328	M 41	Cancer of intestine	....	f x u	Cystoscoped; nothing found	Death	....
329	M 61	Inflammatory	Colon and bladder. 3 B. II. (Kidneys healthy)	f x u	Suprapubic	Autopsy	....
330	F 44	Inflammatory	Cæcum and bladder	f x u	Cystoscoped; orifice found. Laparotomy. Bladder sutured; intestine not sutured	Death	....
331	F	Inflammatory	Colon and bladder	....	Suprapubic; suture	Recovery	....
332	....	....	....	....	Suprapubic; suture	Not cured	....
333	....	....	....	f x u	Suprapubic; bladder orifice sutured; 15 days later operation repeated, again failure	Death	....
334	M 60	Cancer of sigmoid(?)	....				

335	M	Syphilis (?)	Large intestine and bladder	f x u	Suprapubic; orifice not found, and suprapubic failure. Laparotomy. Intestine sutured; bladder not sutured	Death	……
336	M 65	Cancer diagnosed(?)	……	f x u	Cystoscoped; nothing found	No change	……
337	M 40	Inflammatory	……	f x u	……	Death	……
338	M 56	Inflammatory	……	f x u	Cystoscopy; orifices found	No improvement	……
339	M 62	Tumor of bladder	……	f x u	Cystoscopy, suprapubic	Death	……
340	M 13	Operation for stone	Rectum and bladder	u x r	(1) 6 ops., failures—i.e. perineal approach; (2) Colotomy and suprapubic; (3) Fistula op. 4 times	Cured	……
341	F 33	Abdominal operation	Bladder and colon. F.I.	f x u	Stone removed	Autopsy	……
342	F 40	Abdominal operation	Sigmoid, bladder and skin. 3 r	f x u	Laparotomy; bladder sutured, intestine resected and sutured. Drainage	Autopsy	……
343	M 49	Inflammatory	……	f x u	……	Spontaneous recovery of fistulæ	……
344	F 45	Inflammatory (?)	……	f x u	Phosphatic stone found	Result unknown	……
345	F 67	Inflammatory	……	f x u	……	Result unknown	……
346	F 42		……	f x u	Sec. stone found	Spontaneous cure	……
347	M 32	Cancer of bladder	Large intestine and bladder. (Kidneys diseased). 21	f x u	Cystoscopy; ulcer found	Autopsy	……
347	F	……	Sigmoid and bladder	……	……	Autopsy	……

TABLE OF CASES—Continued

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
348	M 64	Inflammatory	Colon and bladder	f x u	Colotomy	Relieved	
349	M 49	Inflammatory	Colon and bladder	f x u	Colotomy	Relieved. Death	
350	....	Inflammatory	Small intestine and bladder	....	....	....	2 mos.
351	M 50	....	....	f x u	....	8 years in good health; nothing done	....
352	M	Inflammatory	Sigmoid and bladder	f x u	Colotomy	Death	....
353	M	Cancer of rectum	....	f x u	Colotomy	....	....
354	M 54	Inflammatory	....	f x u	Colotomy	Relieved. Well for 11 years so far	....
355	M 48	Inflammatory	....	f x u	Colotomy	Relieved for 3 years so far. T. B. of testicles 3 years later	
356	M	Traumatic	Rectum and bladder	rf	Medical; no cath.	Recovery with sinuses	.
357	M	Traumatic	Rectum and bladder	u x v	Removal of foreign body from bladder	Recovery	....
358	M 53	Traumatic	Rectum and bladder	....	Medical	Spontaneous cure; later, stone removed and recovery	....
359	M 37	Traumatic	Rectum and bladder(?)	u x	Sinuses in groin. Cath.	Recovery	
360	F 65	Inflammatory	Sigmoid and bladder	f x u	Laparotomy. Adhesions, mass in left iliac fossa; considered not malignant. Colotomy	Recovered to die 6 months later from pneumonia	2 yrs. and 6 mos.
361	F	Child-birth	Rectum, vagina and bladder	f x u vag.	....	Death by sepsis in 28 days	....

No.	Age/Sex	Cause	Location	Fistula	Treatment	Autopsy	Duration
362	M 28	Appendix abscess	Rectum, bladder and cecum. Purulent cavity orifices. 4	f x u	Medical. (Kidneys not found diseased)	Improved	3 yrs., 3 mos.
363	M 39	Inflammatory	Rectum and bladder	f x u	Cystoscoped orifice found. Medical, including curettage and cauterization	Death	……
364	F 60	Cancer	……	f x u	None; cystoscoped; orifice found	……	……
365	M 45	Inflammatory	……	rf	Cyst.; orifice found. Operation for secondary stone	Death	……
366	F 18	Inflammatory (?)	……	rf	Cyst.; orifice found. Gut resected	Death	……
367	F	Tubal pregnancy	……	……	Orifice found. Laparotomy	……	10 mo.
368	M 54	Inflammation of bowel	Sigmoid and bladder	rf	Cyst.; circular ulcer found. Lap.; feces in wound. Lap. suture and drainage	Death in 6 days	6 mos.
369	F 45	Swallowed pin 11 years previously. Passed pin by urethra	Sigmoid and bladder. 1	f x u	Laparotomy; nil	Improved	Not stated
370	M ?	Lithotomy 21 years before	Rectum and bladder	u x r and f x u	Perineal incision. Suture of rectum. Bladder left open	Not stated	Many years.
371	M 28	Calculus (vesical). Size of hen's egg, passed by R. age of 7 years	Sigmoid and bladder. (Kidneys diseased). Surgical. 1	u x r	Abd. oper. (?). Removal of stone (?)	Died	……
372	F 59	Inflammatory	Sigmoid and bladder. 1	f x u	Cystoscoped; laparotomy; Suture both openings	Cured	……

TABLE OF CASES—*Concluded*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
373	M 35	Inflammatory	Sigmoid and bladder	f x u	Bichloride irrigation	Died 1 year later	16 yrs.
374	F 64	Lifting heavy weight	Rectum and bladder. 1	f x u	Diagnosis by cysto-scope; Laparoto-my; rad. suture	Cured	14 mo.
375	M 44	Inflammatory	Sigmoid and bladder. 1	f x u	Laparotomy; rad.; Suture	Cured 6 months; stone 2½ x 2 inches	?
376	F	Inflammatory	Rectum and bladder. 1	f x u	Application Ag. No. 3 fistulous tract by vagina	Cured	
377	F 60	Inflammatory	Sigmoid and bladder. 1	f x u	Colostomy	Improved	......
378	M 48	Inflammatory	Sigmoid and bladder. 1	f x u	Colostomy	Improved	13 yrs.
379	......	Inflammatory	Jejunum and bladder. 1	f x u		Improved Jewett's	......
380	......	Inflammatory	Rectum and bladder. 1	f x u	Simple incision of skin-phlegmon	Spontaneous healing	......
381	......	Inflammatory; diverticulum	Sigmoid and bladder. 1	......	Laparotomy; resection and suture	Died	13 yrs.
382	......	Inflammatory; diverticulum	Rectum and bladder. 1	......	Laparotomy. Suture of both openings	Cure.	......
383	......	Inflammatory; diverticulum		......	Laparotomy; separation. Suture of both openings	Cure.	......
384	......	Inflammatory	Caecum; bladder; abdominal wall	......	Bilateral exclusion	Died.	
385	......	Inflammatory strangulated hernia	Small intestine and bladder	......	Bilateral exclusion	Cured 8 years	......

costal area. On palpation, at times, the lower pole of right kidney can be caught. Skin and glands negative. Reflexes normal; genitalia normal; considerable arteriosclerosis at radials.

Urine: First, cloudy with shreds; second, ditto. Composite examination of 30 specimens. Alkaline, albumin, trace or none, no sugar. Sp. gr. 1012–1017; pus, epith., cocci and bacilli (colon). No. T. B.; rarely blood cells; at intervals a few cylindroids and hyaline casts; *vegetable cells.* Urethra takes No. 26 French sound with ease, hyperæsthesia posteriorly. Prostate— small, soft. Vesicles, right, normal; left, thickened and tender. Mixed secretion, pus and bacilli. Definite thickening of posterior vesical structures.

Patient put on silver nitrate irrigations, urotropin preparatory to further examination.

February 15, 1908: Remarkable change; gain of 18 pounds in weight; urine almost clear; pus reduced; albumin, trace or none; rare hyaline casts; no blood; vegetable cells. Cystoscoped with Nitze cystoscope. Bladder wall healthy except at trigone. The changes are about interureteral muscle which is raised up; very granular and hyperæmic. The ureteral orifices cannot be seen. On right lateral side of the bladder there is an appearance of a crater with puffed reddened lips, projecting into bladder and about this many cyst-like bodies, described by Fenwick as "bunches of grapes." Left side, double œdematous projections with crater-like opening between the lips. In other words, there may be two orifices of fistulæ.

Proctoscopy. Just below last valve and ½ inch to right of median line two small polypoid villi can be seen. A probe introduced between these villi enters into a canal which runs into the bladder. This can be just reached by finger. Bismuth subnitrate and charcoal by mouth can be recovered in urine.

Diagnosis. Rectovesical fistula. A possible slight secondary pyelitis (right); also arteriosclerosis and possible cirrhosis of liver. Based on (1) history, (2) symptoms, (3) cystoscopy, (4) proctoscopy, (5) recovery of bismuth and charcoal in urine.

On account of general condition of patient, *i.c.,* (1) signs of cirrhosis of liver with a possible hepatic infection, arteriosclerosis (2) and lack of discomfort, local treatment was advised; *i.c.* urinary and intestinal antiseptics and bi-daily vesical irrigations. In addition, fistula to be gently curetted and touched with

silver nitrate, via rectum, with some improvement, *i.e.* no fæces for nine days, gas only three times in same period. Urine: acid, 1016, slightly cloudy. No sugar, no albumin, slight pus, bacilli (colon), rare hyaline casts.

October 20, 1908: Patient is better than he has been for years. Has had no attacks of fever since May 1, has gained to 158 pounds, and his urine is clear, free from smell, and only rarely does he pass appreciable fæces. Gas is still fairly constant.

May, 1909: Patient is in splendid health, no fæces for three months, and air only twice in the same time. Is on daily intra-vesical irrigations. Still under treatment.

A table of cases collected from Chavannaz, Cripps, Pascal, Sachs, from the literature and from personal communications, is printed on pages 266–284.

SUMMARY OF RESULTS.

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Pascal's cases analyzed............................... 346
To which are added................................... 39
    Total No. of cases............................... 385

Medical .............................................. 267
Spontaneous cure ....................................  5
Surgical ............................................. 110
Unknown .............................................  3
    Total ........................................... 385
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	Cured	Impr.	Unimpr.	Not known	Deaths	Total
Medical and Spontaneous	48	17	12	63	132	272
Surgical	36	16	4	7	47	110
Unknown				3		3
Total	84	33	16	73	179	385
Operative cases *	32	11	3	4	41	91
Colostomies	9	2		2	20	33
Laparotomies	13	3		1	17	34
Kidneys diseased †						25

	Cases	Orifices found	Nothing found	Not stated	Ulcer
Cystoscopies	13	8	2	2	1

* Including all operative procedures, cutting of strictures, lithotomies, sphincterotomies (primary and secondary). Deaths are considered operative when dead within three months.

† In 25 autopsies in which condition of kidneys was stated, there was ascending infection 18 times and 15 of these were bilateral.

A STUDY OF ONE HUNDRED AND THIRTY-ONE CONSECUTIVE CASES OF FIBROID TUMORS OF THE UTERUS DEMANDING OPERATION.*

BY ARCHIBALD MACLAREN, M.D.,

OF SAINT PAUL, MINNESOTA.

Professor of Clinical Surgery in the University of Minnesota.

SEVEN years ago Andrew J. McCosh presented a paper to the American Surgical Association, on the subject of Myomectomy vs. Hysterectomy. In reading this excellent paper again, I was surprised to find that it was so sound and up to date. Seven years ago McCosh was, if anything, ahead of his time; but the conclusions which he drew then have borne the test of time. They are as follows:

1. "Myomectomy is possible, advisable, and the operation of choice in young women, even when several tumors demand removal and even if the uterine canal has to be opened, rather than hysterectomy."

2. "In an operation of myomectomy, fear of hemorrhage should be cast aside; bold and rapid methods should be adopted."

3. "The operation is attended by the same danger as hysterectomy."

4. "The ultimate results as regards menstruation, pain, and pregnancy are satisfactory following myomectomy."

When should a fibroid tumor of the uterus be operated upon? When it commences to increase in size or to cause symptoms such as pelvic pain or hemorrhage, either at or between the menstrual periods;—and also occasionally for reflex disturbances such as persistent vomiting, which I have seen on more than one occasion.

Maurice Richardson in answering the question says: "When we postpone an operation on a fibroid tumor we may be causing the patient to run a risk beside which the dangers

of an operation are but trivial." Richardson thinks that the same rule should be followed as in ovarian cyst or in appendicitis in the interval; but that a small subperitoneal tumor need not be removed if it is not increasing in size. When upon examination we find a pelvic tumor, if we are careful we can usually make a correct diagnosis as to the character; but not always. And this is especially true in moderate-sized tumors which just fill the pelvis. It is not always possible to be sure that a certain tumor is uterine and not ovarian in origin; the usual error is to diagnose a small ovarian as a fibroid, on account of its smooth, hard, almost solid feel. Within the past month I have made this diagnostic mistake, even after a most careful examination. Again, we cannot be sure that a uterine tumor is innocent and not malignant in character. For this reason any tumor filling the pelvis should, in my opinion, be explored.

I have taken for the subject of this paper the last 100 consecutive hysterectomies for fibroid disease, and also the myomectomies, 31 in number, which have been performed during this same period of time.

In deciding between these two operative measures, the question of first importance is the age of the patient; a young woman should always have a myomectomy if possible. A young woman often thinks that she does not want to have a child, but a time is sure to come when she will give anything under the sun for the privilege of seeing her own child. After the child-bearing period the uterus should not be left if by so doing the woman is to run any greater operative risk, or if there is much chance of a return of her disease. I find that 70 per cent. of my hysterectomy patients were forty-five years of age or older. One patient was twenty-five years old; one, twenty-eight; and 28 per cent. were between thirty and forty-five years,—while of the myomectomies 87 per cent. were forty years of age or younger. One of the patients, over forty years of age, had been married late in life and was terribly distressed because she had recently miscarried as a result of an intramural fibroid which choked the pelvis. She gladly

accepted the slight additional risk which I then thought would probably follow a myomectomy, and one year later she was successfully delivered. Two years later she had a second child, and I am sure that she is one of the most grateful patients that any surgeon ever had.

After a myomectomy the tumor may reform, or other small growths which were too deeply buried in the uterine wall or were too small to be palpated may increase in size and cause a return of the symptoms and necessitate a second operation. This has occurred three times in my total experience of over sixty myomectomies. Perhaps there have been other cases who have not subsequently consulted me; but of the cases that I have been able to follow—and I believe that I know of the after-histories of most of my patients—the growths have not returned. Of these three cases, two later had hysterectomies, but each was glad that the attempt had been made to save her uterus. In all of these cases the return came inside of two years. After that time the chance of a return is, apparently, very small.

Myomectomy has been done during pregnancy four times with one miscarriage. In each case the symptoms present were threatened miscarriage, one being so acute as to give the attending physician the impression that this young woman was suffering from acute appendicitis with uterine hemorrhage. I would not advise the removal of a uterine tumor in a pregnant uterus which is producing no symptoms. But on the other hand I would not take the ultra-conservative position of some of the best English surgeons who have lately expressed the opinion that myomectomy before the viability of the child is almost never justifiable,—that even after labor has been established obstructing tumors may slide up and slip out of the way. I think a myomectomy just before labor is often the very best way of dealing with obstructing tumors. I remember one—a very large fibroid of the posterior lip of the cervix—completely filling the pelvis and preventing the child's head entering the pelvis at all. This tumor was enucleated from its bed without much difficulty, although there was a

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profuse flow of blood which could only be stopped by packing the cavity with gauze. The attending obstetrician removed the gauze twenty-four hours later, during labor, while the advancing head compressed the cavity and the woman was successfully delivered of two perfectly healthy, vigorous children. She made a perfect recovery and has been absolutely well ever since.

In regard to the mortality: There have been five deaths in the 131 cases, or 3.8 per cent.; 3 per cent. in the series of 100 hysterectomies, and two deaths in the myomectomies, making 6 per cent. This looks like an unjustifiable mortality for myomectomy, but as both were accidental deaths, and in no way due to the myomectomy, they ought not to be charged to this operation. The first was due to the giving away of the catgut purse-string suture about the stump of an appendix which had just been removed. I have already reported this case in a paper on surgical errors read before the American Medical Association at Atlantic City, two years ago. The second death was probably due to the leaking of a gall-bladder which had been opened and drained through a stab wound, several gall-stones having been found at the time of the operation for a removal of a fibroid tumor.

For several years I have been in the habit of always exploring the upper abdomen with the gloved hand, and if the original operation was not a grave one, I did not usually hesitate to remove, after the manner described by Kelly, slumbering gall-stones when found. Some six months ago, when studying up my own statistics of gall-bladder surgery, I was amazed to find that in 20 consecutive pelvic operations where the gall-bladder had been opened and drained in this way, there had been three deaths, while the general mortality of gall-bladder surgery, leaving these 20 cases out of consideration, was only 2 per cent. Since discovering this fact, I have promised myself that I would not again follow this method, but in the future will always make a secondary opening, which can be properly packed, so that the gall-bladder can be more safely dealt with, or in the majority of cases put off the gall-bladder operation to a later and safer occasion.

Now taking up the three fatal cases following hysterectomy we find that one woman died on the third day, as the result of leaving a tape sponge in her abdomen, and this in spite of all the precautions which are thrown about the use of sponges in the abdomen. A miscount was made by one of the most excellent operating nurses that I have ever had. When we open the abdomen for the purpose of performing any operation we know that it is not without danger. All honest surgeons tell their patients that a laparotomy is not without risk; many are apt to say that there is small danger,—say about 2 per cent. The leaving of a foreign body in the abdomen is and must always be one of the sources of danger; the five and ten-yard packing rolls help very much to lessen the risk, but even then we must have some smaller sponges to mop up the blood, and occasionally one of these may escape our notice. I find that every interne, when cross-examined, knows of at least one such case, although they confess with great reluctance and never tell who the operator was.

The second death may have been a case of slow sepsis, producing peritonitis with obstruction. No autopsy could be secured, but as the patient died from obstructive symptoms on the seventh day I have always felt that it was a volvulus unrecognized until too late. A vaginal section was done on the sixth day and nothing but bloody serum evacuated. Her abdomen should have been opened and explored on this sixth day,—or better on the fifth day, as I look at it now. On general principles I am much opposed to secondary laparotomies on patients seriously ill and apparently dying. My recollections of several such attempts to save life have been that they were all unsuccessful. Usually the one chance in this class of cases is to let them alone, hoping that perhaps we are mistaken, and that they are not nearly as sick as we think.

One case died following a panhysterectomy for a sloughing fibroid of large size which was supposed to be malignant. As the tumor was raised out of the abdomen, I saw a few drops of pus drip from the cervix, which I had already closed with stitches, but which leaked just at the wrong time.

Dr. A. E. Herstler of Kansas City has recently described

his bloodless method of hysterotomy in which he uses Moynihan's stomach clamps to control the uterine blood supply and prevent hemorrhage during myomectomy. It seems to me that occasionally this procedure might be decidedly helpful; but judging from my own experience it is not usually necessary. The oozing does not come as a rule from the nutrient arteries of the tumor which Dr. Hertzler ligates, but from the whole raw surface, and from the stitch holes themselves.

One of the principal dangers of myomectomy, as well as hysterectomy, is postoperative hemorrhage. The gradual formation of an hæmatocele, which occasionally follows either operation, should be carefully watched for; because, as Deaver says, "hæmatomata in these cases are dangerous." I have been in the habit of putting in vaginal drainage at the time of the operation, when there was any difficulty in preventing oozing. And twice after myomectomy I have made vaginal section on the third day, opening up and draining such hæmatomata with the most gratifying results. After hysterectomy I have put in vaginal drainage ten times, and on five occasions have later made a vaginal section and put in a rubber tube. Symptoms of collapse, with an increase of pulse rate, will usually give the clue to the condition, and a boggy sensation in the cul-de-sac, especially if the perineum is straddled by one finger in the vagina and one in the rectum, will usually settle the diagnosis.

In my earlier work I lost two cases where the puddle of pus in the cul-de-sac was due to the infected, broken-down blood clot which though it had caused the fatal septic peritonitis was not discovered until the autopsy. To the recognition and drainage of these accumulations of blood more than to any one thing do I ascribe my improved results over a few years ago, when I used to find hæmatomata at the post-mortem. If they are recognized and drained early, the patient will promptly recover. If they are not discovered the patient may recover after a long and stormy convalescence; but she probably will not. There is absolutely no shock after a vaginal section, in this particular differing absolutely from the secondary laparotomy, which is nearly always fatal.

On account of these and other experiences with vaginal section in desperately sick pelvic cases, I have made a rule for myself, that I would not let another woman die without making an exploratory vaginal section, for I have seen some truly wonderful recoveries following this procedure,—and the same can be said in regard to rectal section in men with pelvic or general peritonitis.

The danger of a fibroid tumor producing a suppurative pelvic peritonitis is considerable. In the 100 hysterectomies, three cases came to me with pelvic abscesses complicating the tumor, either due to a perforative appendicitis or to the necrosis of the tumor, or to compression of diseased appendages. Eighteen of these 131 cases had old diseased appendages. As the tumor enlarges it squeezes these old inflamed appendages against the sides of the pelvis and causes, occasionally, a slow leak, and this produces a pelvic abscess. When a fibroid tumor is complicated by a pelvic abscess the abscess should first be dealt with by vaginal section and drainage; several weeks should then intervene before attempting to remove the tumor. Many years ago I allowed myself to be over-persuaded by an anxious patient and operated too soon, removing a large fibroid ten days after a vaginal section for pelvic abscess; as a result I lost the woman with a septic peritonitis. Perhaps she would have died anyway, but by my haste I certainly did not give her the best chance to recover.

In regard to the method of performing hysterectomy: Supravaginal amputation has been the operation of choice, and only in malignant or a suspected malignancy have I resorted to complete removal of the uterus, and then for two reasons: First, because it is a less dangerous operation in my hands, and second, because I have never seen a fibroid tumor grow in the stump of the cervix after a supravaginal amputation. Large sized catgut for the vessels, No. 3 or No. 4, is the best ligature material,—or No. 2 double. It is awkward work tying the uterine arteries deep in the pelvis, and much greater force has to be used than would be necessary on the surface,—so the ligature must be larger and stronger. In my judgment, it is always wiser to cut the uterine arteries beside the cervix

before picking them up,—for they lie very close to the ureter.
The only time that I have ever injured the ureter was in one
of my earlier operations, when the uterine artery was ligated
en masse before cutting the artery. If the danger of injuring
the ureter by a poor surgeon is only one in 200, I do not
believe that the uterine bougies are often necessary.

In regard to complications, I have removed the appendix in
71 cases. Inflammatory disease of the appendages has been
met and dealt with 18 times. Femoral, inguinal and opera-
tive hernia have been met 5 times, goitre once—when the thy-
roid gland was removed before the uterus on account of the
difficulty in breathing. Gall-stones were discovered and suc-
cessfully removed 8 times; gall-stones were found and not re-
moved 3 times; 7 cases were associated with procidentia, and
in these cases the stumps of the round and broad ligaments
were sutured to the stump of the cervix (Dudley). Drain-
age through the vagina was used 10 times at the time of
operation. Vaginal drainage was used after the operation 7
times; all but one recovered, as mentioned above.

In regard to the influence of the fibroid tumor on preg-
nancy: In the 100 hysterectomy cases, 17 of these women had
never married. Twenty-two who were married had either
miscarried or had never had a pregnancy at all. Seventeen
others who were married had not had a child for twenty years;
25 had had their last child between ten and twenty years;
4 had had a child three years and less; the remaining 11 of
the 100 cases had last child between five and ten years.

Fibroid tumors were not removed until they had com-
menced to produce symptoms—pain from pressure on rectum
or bladder—and in 32 cases on account of profuse menstru-
ation, many of them bleeding all of the time. The hæmo-
globin in one case was as low as 20 just before the operation.
This woman made a recovery, but it was much slower than
usual. In this latter class the best way is to keep the patient
in bed in the hospital under observation and forced feeding,
with big hot douches twice a day, postponing the operation
until the day when they commence to flow.

RESECTION OF THE SCIATIC NERVE.

NEUROPLASTY: END RESULTS.*

BY KENNETH A. J. MACKENZIE, M.D., L.R.C.P. & S.E.,

OF PORTLAND, OREGON,

Professor of Operative Surgery in the University of Oregon; Surgeon to
St. Vincent's Hospital.

ALTHOUGH a great deal of work has been done in the field of surgical neurology it is surprising how limited the general knowledge is at the present time concerning the phenomena that attend recovery of function when peripheral nerves have been destroyed or injured. The belief is almost universal that after a divided peripheral nerve has been reunited successfully recovery takes place within a very short time, whereas the process is very slow.

More than a quarter of a century ago Létiévant demonstrated that after division of the median nerve moderate pressure of a blunt object could be felt over the entire area affected. This applies to all peripheral nerves. Létiévant believed that this phenomenon was explained by the intimate anastomosis existing between nerves, the overlapping of sensory areas, and also by vibration communicated to sensitive nerves in neighboring territory. Until Sherrington demonstrated that the motor branches of mixed nerves carried with them afferent sensory fibres whose course he traced through the muscles and tendons of the arm and hand, this apparent paradox was not understood. These afferent fibres are now known to account for the residual sensibility after all the sensory nerves distributed to a part have been divided.

Wonderful additions have since been made to the knowledge of this subject by a remarkable series of studies and experiments made by Head, Rivers, and Sherren. They have not only been successful in giving finality to the problem of

deep sensibility, but they have placed us in possession of the knowledge that there are other sets of afferent nerves, which, associated with those mentioned, through their end-organs and fibres, receive and convey stimuli so definitely that their identification becomes easily susceptible of proof. To those who are not familiar with this literature it may be interesting to learn that the experiments which have imparted such *éclat* to the joint labors of this triumvirate were made on the person of Dr. Head himself, who submitted in April, 1903, to an operation in which both the radial and the external cutaneous nerves were divided. In proof of their painstaking methods of investigation, their work on this case extended over a term of years and was published in *Brain* in November, 1908.

Their conclusions are that the afferent fibres in the peripheral nerves can be divided into three systems: First, those which subserve deep sensibility and conduct the stimuli produced by pressure. Second, those which subserve protopathic sensibility. This system of fibres and end-organs receives and conveys painful cutaneous stimuli, and the extremes of heat and cold. These fibres regenerate rapidly after successful operation for repair of divided nerve. Third, those which subserve epicritic sensibility, The nerve-fibres and end-organs of this system endow the part with the power to respond to light touch and enable one to discriminate the two points of the compass, and also ordinary temperatures, warm and cool. Epicritic sensibility is very slow in returning.

Contrary to the accepted doctrine that sensation in its recovery spreads from the normal part over the anæsthetic area, they have proved that the reverse is the case and that protopathic sensibility, latent for a time, develops first at the outer confines of the analgesic area, spreading slowly towards its centre; in the meantime the epicritic area of sensibility remains unchanged and its outer lines can readily be defined by the cotton-wool test.

With the spread of protopathic sensibility over the analgesic area the end-organs become extremely sensitive, and at this stage of regeneration pressure causes not only the sense of

pressure, but a sensation of bruising and contusion; prick causes intense pain accompanied by tingling, which is very widely diffused, differing entirely from the effect of prick over the normal skin, at the same time localization of the pressure point is uncertain; extreme heat and cold at this time cause painful diffused sensations without the power of discrimination of heat or cold. Even when the process of regeneration and recovery has progressed thus far, the zone of epicritic sense remains absolutely unchanged.

When the diffusion of protopathic sensibility is at last complete, for a long time afterwards the affected area continues to be extremely sensitive to painful stimuli.

It is generally about this time that the epicritic sensibility begins to spread gradually over the affected area; diffusion of both in time is complete and when complete recovery is absolute. The supreme test of complete recovery of sensation is determined by the compass test; the appreciation of the two points two centimetres apart, applied simultaneously to the skin surface.

It is evident that after division of a nerve regeneration and complete recovery of function must solely depend upon conduction restored either by spontaneous healing, primary or secondary suture, or plastic device.

Protopathic sensibility appeared after successful surgical repair of the divided median nerve within an average period of fifty-six days, and was complete within an average period of two hundred and seven days.

Epicritic sensibility, under like conditions, appeared after two hundred and sixty days and was seldom completed within less than a year's time.

It is interesting to note that protopathic sensibility can be restored under conditions in which motor and epicritic recovery are impossible; and this fact is of clinical importance because of its bearing upon the cure of those serious trophic disturbances which, very often, follow the division of nerve-trunks. That complete regeneration can take place in divided peripheral nerves after three years is held doubtful, but within this period many successful cases have been reported.

In the case reported in the present communication a different set of conditions exists, which must be taken into account in gauging the measure of recovery and regeneration accruing from the operative treatment.

The lines (Fig. 5) which have been tattooed on this leg show with fair accuracy the present boundaries of the different areas. The outer line bounds the whole region and the area insensitive to light touch. The line next within marks that part of the whole affected area which is insensitive to pinprick. Between these two lines is the zone of protopathic sensibility, which through its end-organs and fibres receives and transmits painful stimuli and extremes of heat and cold. It is not sensitive, however, to ordinary stimuli originating with ordinary temperatures, warm or cool (see Fig. 6). The darker of the two shaded areas marks the region which responds to the stimuli of deep pressure, which is, however, felt on both sides, shading where it is most readily felt to the next line without, and where it is least felt into the black area. Within this zone there is no response to prick and to temperatures of any degree, hot or cold. The innermost black region marks the area of absolute cutaneous anæsthesia and analgesia —even within this area there seems to be a remnant of response to the stimuli of deep pressure.

A study of the areas of disturbed sensibility in this case brings out the fact that the small sciatic nerve was divided at the time of the enucleation of the great sciatic. The boundaries of this area are also tattooed and show extensive protopathic recovery.

REPORT OF CASE.

GEORGE ELLSWORTH CARLISLE, single, æt. 45, height 5 feet 6 inches, weight 150 pounds. Born in Steubenville, Ohio. Complexion dark, eyes black, hair black. Occupation at intervals nailmaker, hospital steward, dining-car cook. Mother and father were both Americans. Paternal grandfather was an American. Maternal grandmother was French (French Provinces). Had four brothers: one living and well; three dead; two died past age of thirty, cause of death unknown. One died at thirty, cause

of death unknown. Had five sisters, two living and in good health. Two sisters died before he was born. One sister was burnt to death. His mother was afflicted with rheumatism. There is no history of consumption or other constitutional disease in his family. No member of his family is known to have had the skin disorder from which he suffers. At birth he was strong and in childhood he had no diseases or injuries. In adult life he had pneumonia, a mild attack, uncomplicated. He has never had syphilis.

The eruption from which he suffers developed at first in 1888, when he was twenty-five years old. Small, round, soft tumors appeared in the centre of his back, ranging in size from a millet seed to a split pea. Upon first discovery there seemed to be a large number of these growths. There were none visible at the time on the neck, face, or front of the trunk. These little tumors grew very slowly, a few of them attaining the size of a small bean. Small growths of the same kind next appeared on the forehead and temples, and in the neck, where they seemed to attain larger dimensions. Most of them were sessile, a few almost pedunculated. At this stage a few developed in the hairy scalp, but not more than three or four. The growth of these tumors has been much more rapid during the last ten years. The small growths are, generally speaking, papular in form; not a few are oval and others are circular. They are soft in texture, many of them have a yielding, velvety touch, and in a few instances the larger ones resemble in touch the soft form of lipoma. He states that on the face and chest many of these lumps would appear and grow as large as a pinhead and then slowly disappear by absorption, leaving a brown stain. A few developed on the anterior surface of the chest. The great majority of them are the size of millet seeds; between twenty and thirty of them have attained dimensions ranging in size from a pea to a good-sized almond (Figs. 1 and 2). Some of the tumors are shaped like a nipple, and others are cone-shaped. Considering their diffusion there is an apparent symmetry in their distribution, although the right hand is free, while the left is moderately involved.

In 1898 one of the tumors about the size of his fist was removed from the right arm above the inner condyle of the humerus. After its removal, the patient says the hand became

weak and the little finger and the adjacent side of the ring-finger became numb, and he could not move them, although motion returned to them two or three months afterwards, and within six months the affected hand was quite as available as the other.

At this time, while he can flex the fingers completely, he cannot extend them and there is a well-marked protopathic area, showing that the ulnar nerve was divided and not reunited. One year after the operation the muscles between the thumb and index-finger became atrophied. Practically, the growths extend down the legs to the knees, but not below, and there are none on the feet. The largest growths are, generally speaking, found on the right side of the body. There is much staining of the skin and the staining has developed, he states, since he has had this disease.

In May, 1907, patient noticed a slight swelling on the posterior mid region of the right thigh, which was painful, sensitive, and exceedingly tender to the touch. The pain accompanying the swelling passed away after two months but returned in December after it was accidently struck in climbing through a window to escape from a wrecked car. Immediately after this injury the lump in the centre of the thigh grew rapidly and became very painful. He was obliged to give up his occupation at the end of December, and by the middle of January, 1908, the pain was so severe that he could not stand or walk without great suffering. The slightest pressure over the tumor would cause the most intense local pain, which was transmitted down the leg and diffused over the foot. The pain becoming finally unbearable, he entered St. Vincent's Hospital.

Examination revealed a tumor, as large as a goose-egg, over central part of the right thigh, over the sciatic nerve, pressure on which would almost put the man into convulsions. Locomotion was difficult, and there were scattered areas on the leg of hyperæsthesia and anæsthesia; the latter, although unmeasured, were evidently in excess of the former. There was also a paretic condition of the muscles of the leg and foot on the affected side.

The diagnosis that was made at the time was: Tumor, probably of analogous nature to those on the body, growing on the sheath of the sciatic nerve, which by pressure produced the motor and sensory disturbance complained of.

The first operation was performed on February 4, 1908. A median incision was made over the tumor, extending from its upper to its lower limits. The tumor thereupon presented and proved to be the sciatic nerve with its contents, intimately adherent to the contiguous parts by inflammatory exudation, and adhesions, many recent, others well organized and dense. The incision was extended upwards to the lower border of the gluteus maximus, and below to the centre of the popliteal space. By dissection, blunt and sharp, the sciatic nerve was finally freed and segregated (Fig. 3). The whole nerve now resembled a large, fusiform tumor, every part of the nerve being involved, and extending below well to the point of bifurcation, the external and internal popliteal branches also showing conspicuous enlargement. Examination of the nerve carried with it the impression that the fusiform enlargement of the nerve was a tumor involving the whole nerve, and not, as it proved to be afterwards, a condition in which the nerve invested a large central tumor. This feature was carefully investigated at the time because of the belief that the tumor was a development of molluscum·fibrosum in an unusual situation.

The surgical procedure had now to be quickly determined. (1) The rapid growth of the tumor; (2) its infiltrated condition and its tendency to infiltrate the surrounding parts; (3) its great dimensions, involving the entire area of the nerve; (4) the loss of outline of nerve structure and its evident displacement by pressure and infiltration; (5) the loss of muscular power, which was progressive; and (6) the extensive areas of anæsthesia and hyperæsthesia, not to mention (7) the great pain, and the mental and nervous strain, which by this time amounted to anguish—these considerations, and (8) the suggestion of malignant transformation of a benign growth, prompted me to the determination that excision of the nerve was the proper procedure. The upper section of the nerve was made at the lower border of the gluteus maximus between the tuberosity of the ischium and the greater trochanter, and the lower about one inch below the apex of the popliteal space.

During the resection of the nerve every effort was made to preserve any visible branches. The small sciatic nerve was not differentiated at the time of the operation. Hemorrhage was moderate and easily controlled. The anatomic parts were then

restored as carefully as possible, the wound closed in layers with iodized catgut, and the skin cut closed throughout with a subcuticular iodized suture. The patient returned to bed in very good condition. The first dressing was made on the tenth day and it was found that union had taken place throughout by first intention.

An inspection of the tumor (Figs. 3 and 4) showed the entire nerve hard, dense, and infiltrated, and palpation failed to reveal the outlines of a central growth. The tumor was fusiform in outline, flattened anteroposteriorly. On all sides, especially anteriorly, its surface showed adhesions, recent and old. The outlines of the nerve-tissue, excepting at the ends, were lost on account of infiltration and inflammatory exudation.

The segment removed was 10¾ inches in length, the diameter at its greatest part was about 3 inches. At both ends, where the tumor tapered from its central enlargement, the surface of the tumor was smooth and regular; but in the middle part the surface was extremely irregular and nodular throughout its circumference, showing that the growth had infiltrated into the whole tissue of the nerve between the bundles of nerve-fibers, and that the tumor was not a localized growth of the sheath of the nerve in which the whole nerve was stretched over the growth intact.

Upon section of the nerve by vertical incision a tumor presented itself, oval in form, its long axis lying parallel with the axis of the nerve, consisting of an exuberant mass, somewhat dense in texture, tough, hard, and fibrous, bleeding readily on the surface on examination, and bulging rather suddenly through the lips of the incision. It measured 2 inches in length and 1½ inches in its longest diameter. The tumor seemed to be encapsulated and intimately adherent to the nerve. On its anterior and posterior surface it approximated the periphery of the nerve, but on its lateral aspects it was densely covered by the nerve, although the effects of pressure could be noted upon the nerve in all directions, causing absorption and attenuation of structure, excepting the inflammatory tissues on the outside of the nerve, which were very dense, irregular, and exuberant.

The chart showing no variations of temperature, the dressings were removed on the tenth day and the wound found to be entirely healed. Examination of the leg showed that there was

Fig. 1.

Fig. 2
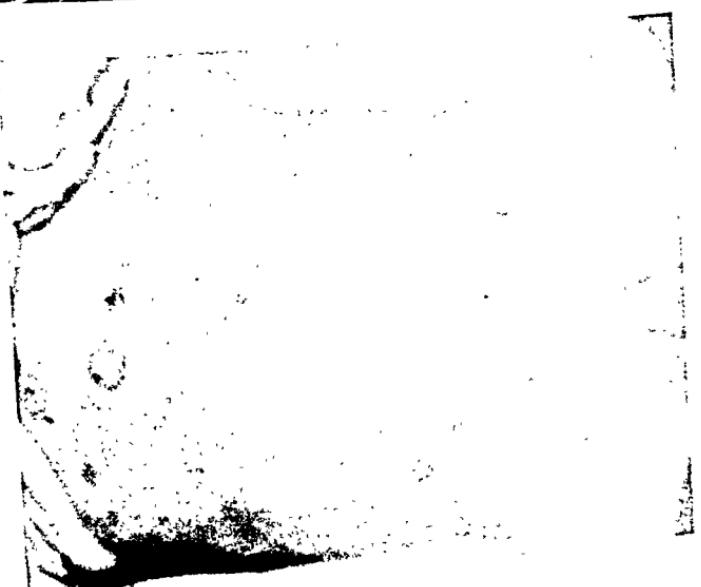
Showing distribution of molluscum fibrosum.

FIG. 3.

Segment of sciatic nerve removed. Posterior view. About two-thirds natural size. Note loss of nerve tissue by exudation and infiltration.

Fig. 4.
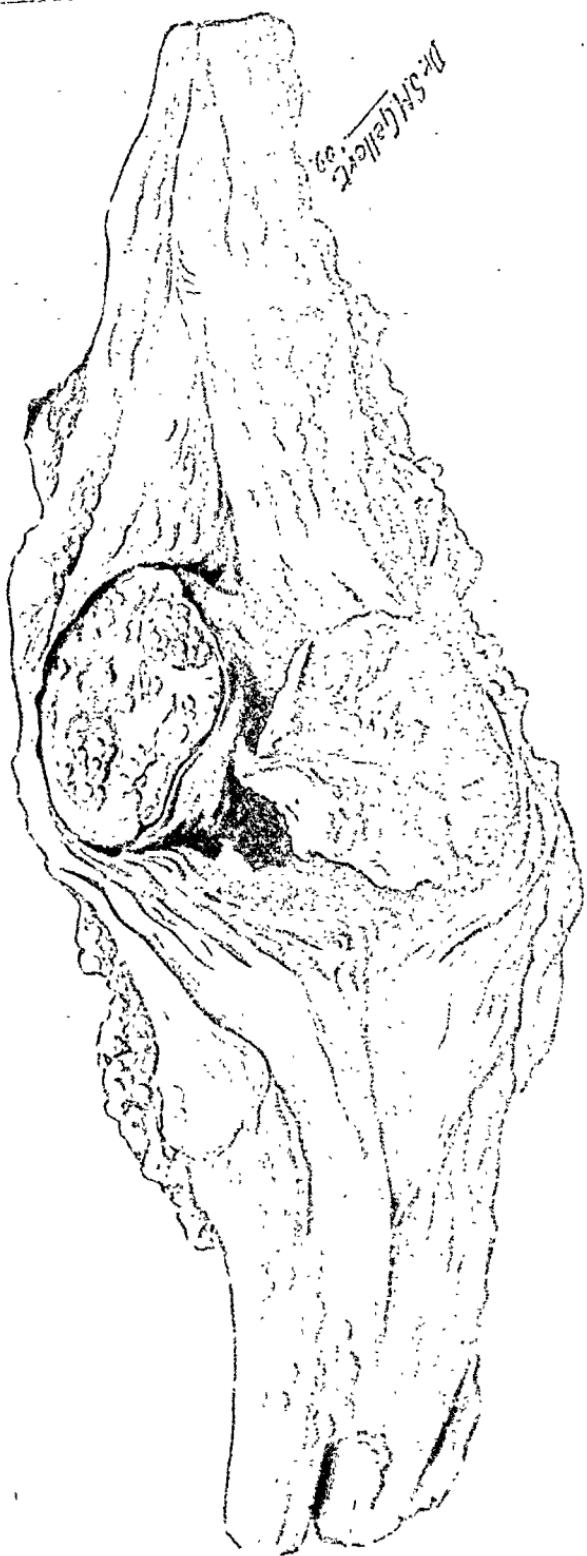
Segment of sciatic nerve. Anterior view, central tumor. About two-thirds natural size. (Drawn from specimen by Dr. S. M. Gellert).

FIG. 5.

FIG. 6.
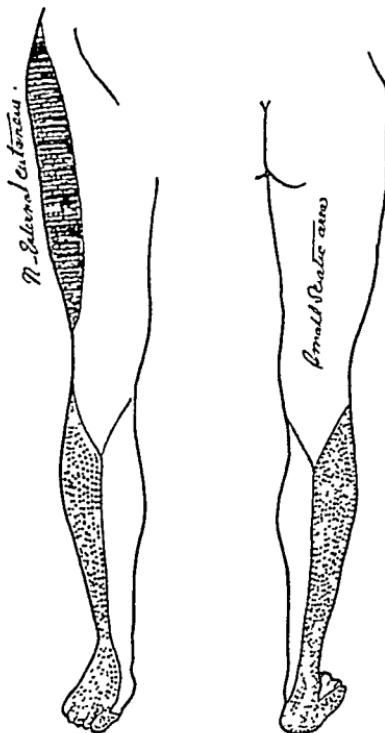
The dotted area represents approximately the sensory area supplied by the greater sciatic nerve. The plain white area represents the sensory area supplied by the anterior crural nerve. Note the sensory area independently supplied by the small sciatic nerve and compare it with diagram (6) displaying the areas and degrees of impaired, lost and recovering sensibility in this tract.
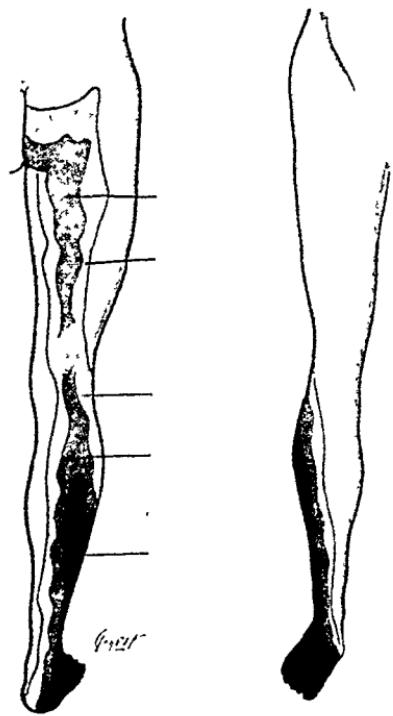
The outer dark line bounds the whole affected area and displays the entire region insensitive to light touch (cotton wool). The next line within bounds that part of the whole area insensitive to pir·· ·· ·· ·· ·· ·· two lines is the zone of ·· ·· ·· ·· ·· ·· which registers painful ·· ·· ·· ·· ·· ·· of heat and cold, but not intermediate temperatures. The darker shaded area next within is entirely insensitive to painful stimuli, but responds readily to deep pressure. The black area next within includes the zone of complete anæsthesia,—even in this area there is a remnant of response to deep pressure. Note in comparison with diagram (5) in the area of the small sciatic nerve; 1, the large area of epicritic sensibility (white); 2, the large area of protopathic sensibility (grey); 3, the small area of complete anæsthesia.

absolute paralysis of the leg, and that sensation was abolished except along the inner side of the leg corresponding to the sensory area of the anterior crural nerve. In addition to this the skin of the leg was purplish-red in color and its surface was freely covered with superimposed epithelium and a few medium-sized blebs appeared on the outer aspect of the leg and the dorsum of the foot. The leg was swollen and œdematous.

It is unfortunate that at this stage of the work no minute examinations were made to delimit the area of cutaneous anæsthesia.

Realizing that the leg in its existent condition was little better than no leg at all, it was determined at this time to bridge the gap in the sciatic by making a flap from the internal popliteal nerve in order (Fig. 14), if possible, to establish a path for the conduction of motor and sensory impulses, and at the same time to promote regeneration and to avert the catastrophe of serious trophic change. Accordingly, Carlisle again appeared before the clinic on February 20, 1908, and an incision was made from a point between the tuberosity of the ischium and the greater trochanter, following the line of the original incision in the thigh and extending to a point immediately behind the internal malleolus; the entire length of this incision was two feet six inches.

The central end of the sciatic was found retracted above the level of the lower border of the gluteus maximus. The ends of the popliteal nerves were now recovered, and as part of this operation the end of the external branch was implanted and sutured into the end of the internal branch (lateral).

The internal popliteal nerve, which was still enlarged, was then traced by careful dissection to the inner side of the ankle, and, beginning at the level of the lower border of the internal malleolus, a flap was lifted and split upwards, care being taken at every step to avoid the division of any collateral branch. The division and lifting of this flap was continued upwards to within half an inch of the divided end of the internal popliteal.

The flap was 16¾ inches in length and its diameter a shade less than one-half the diameter of the nerve. It was then laid in the bed of the sciatic nerve and, notwithstanding its length, on account of the retraction of both the divided ends of the sciatic there was little or no slack. Its end was then implanted in a split made in the stump of the sciatic nerve and held by two very

slender chromic stitches. This slender filament was about a line and a half in diameter and seemed to contain two or three fibres of the nerve. It was carefully placed over the underlying muscles and imbedded in them throughout its length by a slender iodized catgut suture.

Although the technic of the operation was somewhat elaborate the operation was not prolonged beyond one hour's time. The anatomic parts were then carefully restored in proper relation, sutured in layers, and the entire length of the cutaneous incision closed by a subcuticular iodized catgut suture, a small cigarette drain being left in the popliteal space. The leg was invested in a plaster cast and the leg and thigh adjusted at an angle of 140 degrees. The first dressing was made on the tenth day, and revealed the fact that this long incision, which exposed at least one square foot of surface, had united throughout *per primam.*

Examinations of the leg were now made from day to day, and there was no change noted, but that the leg could be very feebly flexed and it was evident that improvement had taken place in the texture of the skin, which seemed to possess better color, and hereafter the tendency to the formation of blebs and ulcers seemed gradually to pass away.

Believing now that if the transplantation of a few fibres split from the popliteal nerve bridging this large gap in the sciatic nerve would do good by establishing conductivity and promoting regeneration, the addition of a few more fibres might augment the benefits, a third operation was done on April 7, 1908, 67 days after the first operation and 46 days after the second operation. The patient in the interval had been allowed to sit up and move about in a wheel chair, and the limb was handled daily by massage, etc. The third operation consisted in an attempt to split the external division of the sciatic nerve in order to utilize it in the same manner. Incision was made throughout the entire length of the leg as in the previous operations. A careful inspection and dissection of the field of the first operation enabled one to note a definite path of nerve-tissue established in the sciatic gap. The dissection of the external popliteal was much more difficult, but it was finally traced to the same length as the internal and a flap lifted up and placed in the sciatic gap, and tucked in a separate muscular bed to the outer side of the other branch, its ends implanted into a niche previously cut in the stump of

FIG. 14.
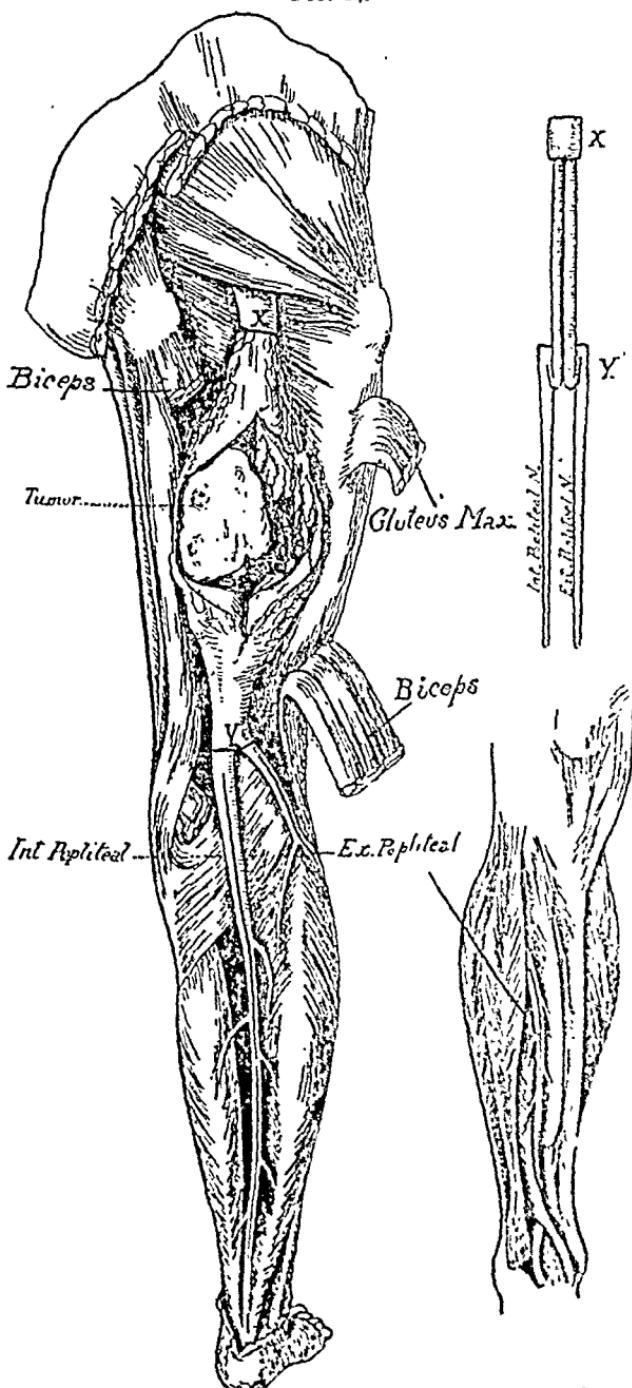
Diagram to show the position of the tumor, the part resected, and the method of restoration of the internal and external popliteal nerve; also the scheme of suture. (Sketch by Miss S. Hayes).

the sciatic nerve. It was noted in this dissection that only a very moderate amount of scar tissue had formed in the line of the first transplantation. The wound was closed and dressed in the same manner as in the previous operations.

After two weeks the cast was removed for dressing and inspection, and the wound was found to have healed for the third time throughout by first intention. Two weeks later the cast was removed and an adjustable splint applied, which permitted the leg gradually to be extended to a straight line. Hereafter treatment by massage and electrotherapy was instituted and has been continued, more or less, throughout. Examinations showed no change in the areas of sensory disturbance, but it was manifest now that the leg could be bent upon the thigh with more freedom and energy, although it was noticed that there was very little muscular power in the movement.

The external appearance of the leg was at this time flabby and shrunken, the skin harsh and of a purplish color, with a tendency in areas to the collection of epithelial scales in layers. The affected muscles of the leg and thigh became flabby and flaccid, and wasted and failed to respond to the faradic current, and were the seat of the reaction of degeneration. Trophic conditions, however, by this time had improved, and there was now no tendency to the formation of blisters, blebs, and ulcers, although slight traumatisms had led to the loss of one or two nails of the foot. When he was permitted to walk after the removal of the plaster cast, there was no pain or discomfort, other than what was described as a numb, heavy sensation in the leg and foot. Attempts at locomotion showed at this stage an ability to flex the leg upon the thigh moderately, but the condition of foot-drop was absolute. Whenever the leg was flexed it was promptly extended, but the foot dragged in the most helpless way, the position of the foot with reference to the leg being that of a flail. The attitude of the foot is mentioned as showing the loss of every vestige of muscle control.

Electrical observations taken about two months after the last operation showed reaction of degeneration [R. D.] in the hamstrings supplied by the sciatic and also the flexors of the leg and the flexors and extensors of the foot. Observations made four months later, that is, six months after the last operation, showed only partial R. D. of the hamstring muscles and the flexors of

the leg, but complete R. D. of the flexors and extensors of the foot. Observations taken in April showed normal electrical recovery of the hamstrings and the flexors of the leg, partial R. D. of the extensors of the foot, and complete R. D. of the flexors of the foot.

ANALYSIS OF THE EFFECT OF THE INJURY.

The excision of the sciatic nerve *in toto* predicates the elimination of all motor and sensory transmission throughout the area supplied by the sciatic nerve and its derivatives. It has not been shown that by anastomosis or the overlapping of territory the anterior crural nerve can contribute much towards the rehabilitation of a district that has been blighted by the removal of the sciatic. Clinical evidence protests the contrary; the sciatic nerve was divided at the level of the gluteus maximus, the first fibres delivered to the hip-joint were probably untouched; the muscular branches distributed to the flexors of the leg, namely, the biceps, semimembranosus, semitendinosus, and the branch to the adductor magnus, were divided. These muscles afterwards wasted and showed a state of flaccid atrophy and paralysis. It is not necessary to say that the entire area of sciatic sensory distribution, that indicated by the diagram, was entirely cut off.

It is more interesting in this study, which involves so intimately the problem of regeneration, to take into account the motor disturbance; and attention is called to the fact that in addition to the hamstring group of muscles already mentioned the muscles supplied by branches of the internal popliteal nerve, namely, the gastrocnemius, plantaris, soleus, and popliteus, were deprived entirely of their nerve-supply, and this group wasted very rapidly and promptly showed the reaction of degeneration; that the flexors of the foot, the tibialis anticus, the extensor longus digitorum, the extensor longus hallucis, and the peroneus tertius were shorn of their nerve-supply and underwent the same paralytic changes; that through the external popliteal branch the extensors of the foot, namely, the tibialis posticus, the flexor longus digitorum, and the flexor longus hallucis, were similarly involved, and likewise the peroneal group and all the groups of smaller muscles of the foot.

I have individualized these muscles and groups of muscles in order to afford a better grasp of the extent to which regeneration has taken place as indicated by motor recovery. It was for a long time held doubtful that regeneration could take place in a nerve in which continuity was lost by division or excision of a segment. It is now known that regeneration will take place over short gaps without previous repair. Hueter has pointed out that it is impossible for regeneration to take place in a nerve over a gap of 1¾ inches or more. Victor Horsley, confirming in general the observations of Heuter, places the limit, from the standpoint of his experience, at 1¼ inches.

It is submitted in this case that a gap of 10¾ inches was made in the sciatic nerve; that, immediately after the removal of the nerve, not only was all sensory and motor transmission eliminated throughout the sciatic area, but in addition all means of conveyance of stimuli by afferent nerves of whatsoever kind; that extensive regeneration has taken place by virtue of an operation in which a gap of 10¾ inches in the sciatic nerve was bridged by two delicate flaps 16¾ inches in length lifted from the two main branches of the sciatic nerve; and that the process of regeneration is progressive are now beyond doubt, and in proof that regeneration has taken place the evidence is listed as follows:

1. Trophic recovery is practically complete. There is now no tendency to the formation of blebs and ulcers and the skin has recovered its natural texture and color.

2. There has been extensive development of protopathic sensibility, much more than could possibly be explained by overlapping from the district of the anterior crural nerve.

3. There has been much recovery of epicritic sensibility, as shown by comparison of the areas of sensory distribution in both legs by diagram.

4. There is almost universal recovery of deep sensation, which is said to be lost when all motor and all sensory nerves to a given part are divided.

5. Recovery has taken place of motion and power in large groups of muscles, which immediately after the excision of

the nerve were reduced to a paralytic state, displaying the usual signs of paralysis and the reaction of degeneration, viz.: (*a*) The flexor group in the thigh: the complete recovery of the semimembranosus, the semitendinosus, and the biceps. (*b*) The flexor group of the leg, the gastrocnemius, the plantaris, the soleus, and popliteus: extensive recovery has taken place in this group and it is progressive. (*c*) The flexors and extensors of the phalanges and foot. Minute examination of these muscles show them now to be firm, strong, and capable of contracting; and while they do not move the foot, they control it, and there is no tendency to foot-drop; some of the muscles of these groups now show only partial reaction of degeneration.

6. The sign afforded by the foot. In the earlier stages of locomotion the foot was helpless and dragged; at the present time it shows muscular control and easy locomotion.

7. The relatively small and contracted area of absolute cutaneous analgesia.

8. The relatively small area of thermic anæsthesia, which is practically coterminous with the area of absolute analgesia.

9. The direct sensibility of the new nerve-tract to deep pressure and the transmission of painful sensibility thereby to the foot.

10. The possession of muscular sense unimpaired.

11. Independent and unaided locomotion.

The following factors may be mentioned which have contributed to the successful results in this case:

(1) Early operation, which the writer believes to be imperative. It might have been better if the neuroplastic work had been done immediately after the removal of the tumor. (2) Implantation in the gap of a large "nerve-element" to establish a nerve-path and foundation for regeneration. (3) The infolding of the nerve-flap in muscular bed so as to prevent the destruction of the delicate nerve fibrils by early formation of scar tissue. (4) The impetus to regeneration of large and dense termini, especially at the central end. (5) The absolute asepsis in three successive operations.

Conclusion.—The lessons to be learned from this case.

while not manifold, are important. It tends to show that regeneration takes place from the peripheral as well as from the central end of a divided nerve.

It demonstrates that in given cases peripheral flaps will suffice when central flaps are not available.

Its most obvious lesson, however, rests in the fact which it discloses that by means of plastic operations regeneration on a large scale and recovery of sensation and motion on a corresponding scale can take place after injuries to and operations upon peripheral nerves from which segments have been removed of varying lengths, the limit established by this case being 10¾ inches.

NOTES ON MOLLUSCUM FIBROSUM.

According to Von Recklinghausen this condition develops from the cutaneous nerves and belongs to the neurofibromata. According to Ribbert the cause rests in some disturbance of normal development, as a result of which there is an irregular distribution and arrangement of the connective-tissue elements of the nerves, permitting independent growths. Von Bruns includes molluscum fibrosum, plexiform neuroma, lobulated elephantiasis, pigmented moles, the soft warts, and fibroma of the large nerves under the title of elephantiasis nervorum.

Neurofibromata are relatively common; they grow from the ends of nerves, also from the connective-tissue and perineurium, and are often traversed by nerve-fibres which have been detached by the growths. Tumors of the large nerves grow as a rule very slowly and develop in middle age.

Von Büngner states that sometimes they attack all the nerves, and that in 12 per cent. of general neurofibromatosis fibro- or myxo-sarcoma develops from one or other of the nodules. Garré describes these conditions as secondary

FIG. 7.

Upper End.

Sect. 1

Sect. 2

Sect. 3.

Tumor

Sect. 4.

Tumor.

Sect. 5

Sect. 6

No. 9654.

Sciatic Nerve.
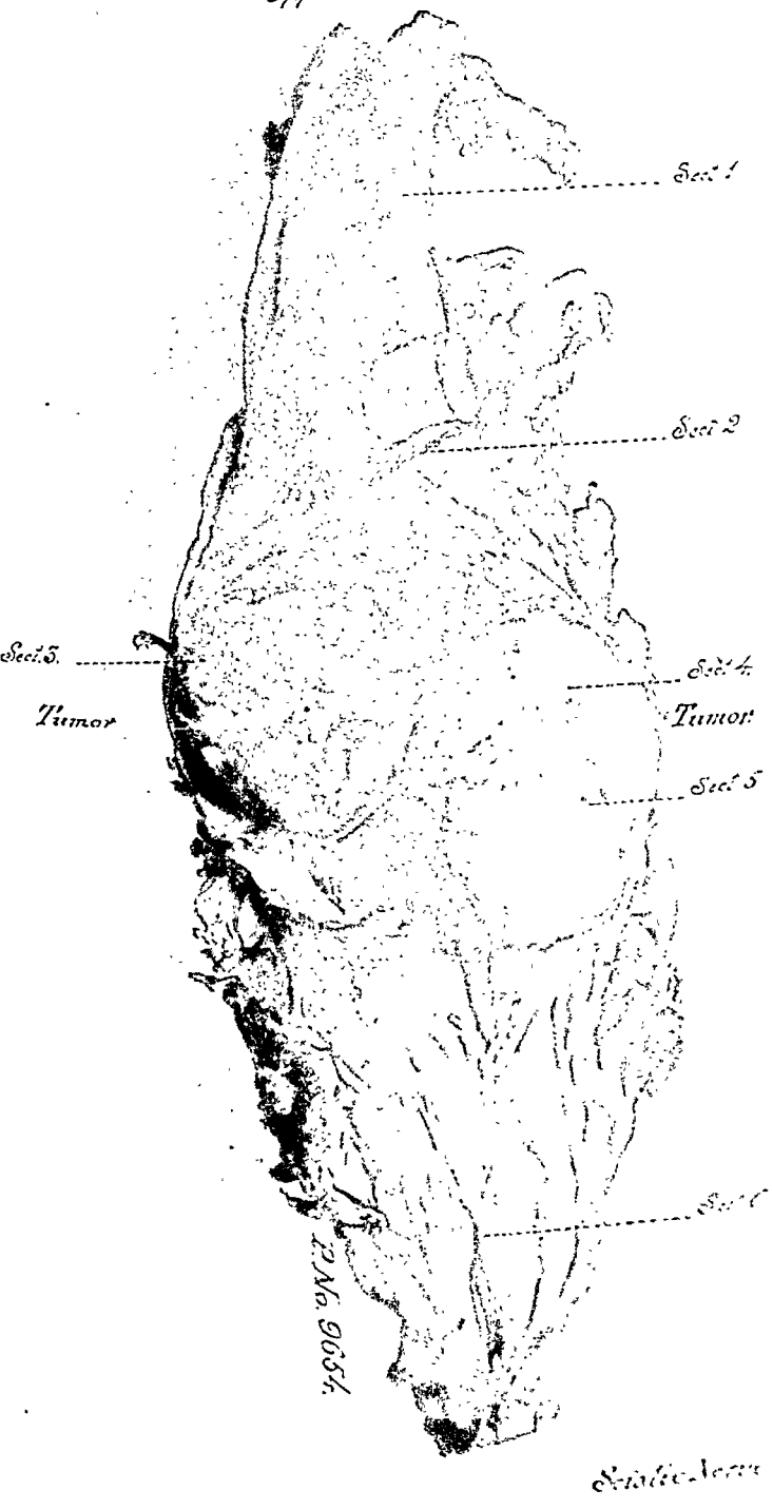
McKenzie's Case.

FIG. 8
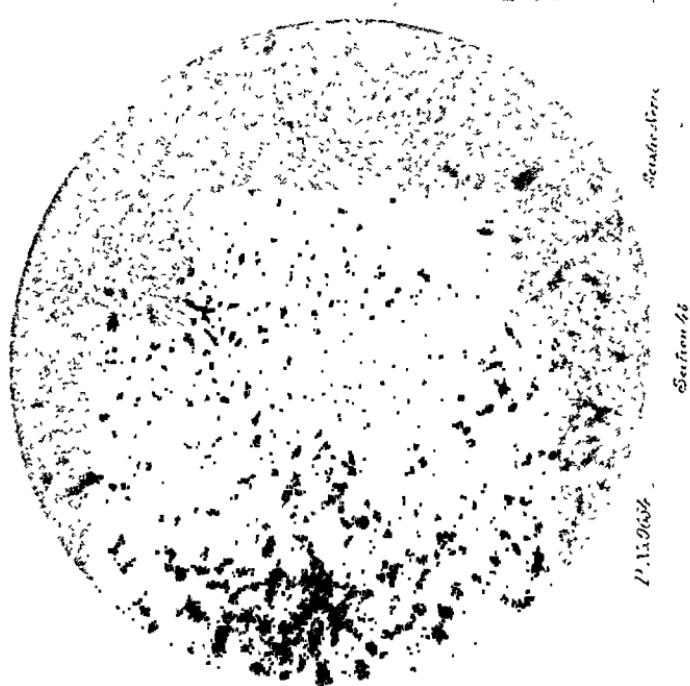
The tumor proper—cellular portion; chiefly spindle cells in a fibrous and myxomatous stroma. (The photomicrographs were made by Mr. Herman Schapiro.)

FIG. 9.
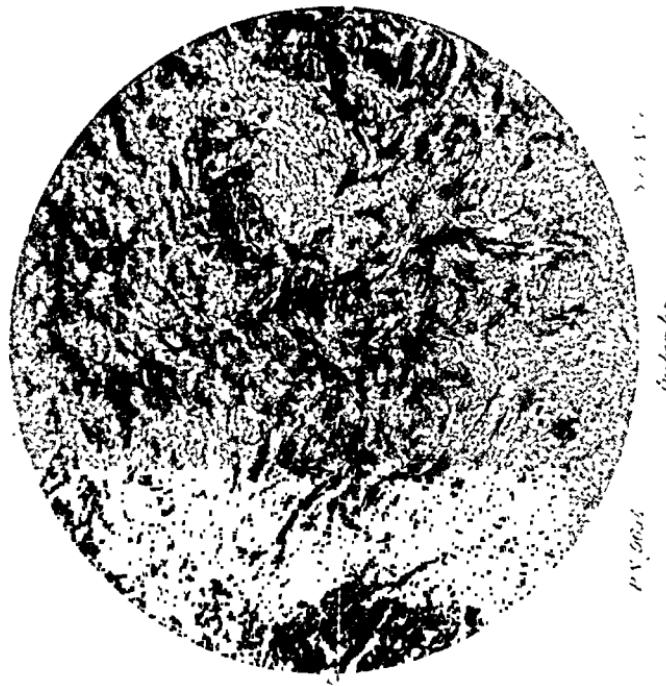
Portion of tumor stained with Mallory and Wright connective-tissue stain. In this area the tumor was much less cellular than in Section 4,b. N, apparently the remains of a nerve fibre.

Fig. 10
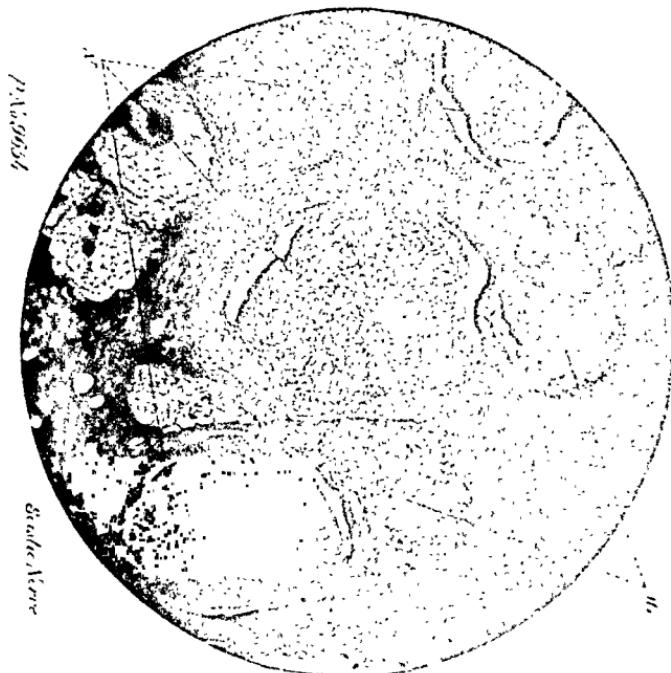
Nerve, upper end. *Mx.* myxomatous residues seen in epineural tissue. The three nerve trunks (*N*) show very little degeneration.

Fig. 11
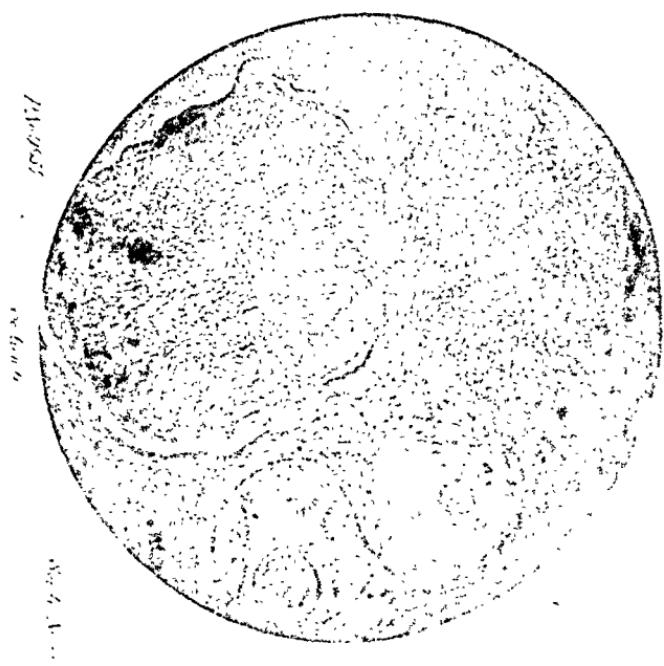
Lower end of nerve. The nerve trunk is larger than in Section 1; there is an increase in endoneural tissue; there is some degeneration of axis cylinders and sheaths. The rudiment shown in Section 1 is also seen here.

FIG. 12
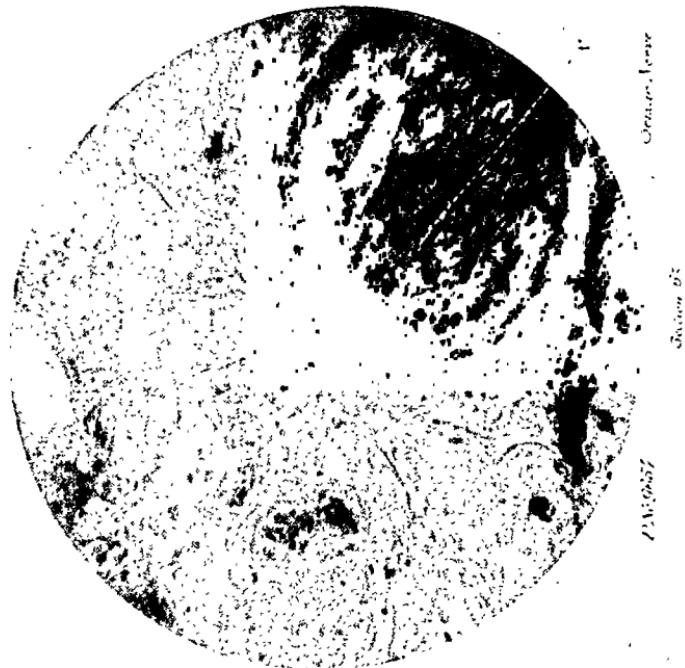
High-power photomicrograph of area marked *Mx* in Section 6, showing myxomatous tissue of the congenital rudiment surrounding a small nerve trunk, *N*.

FIG. 13.
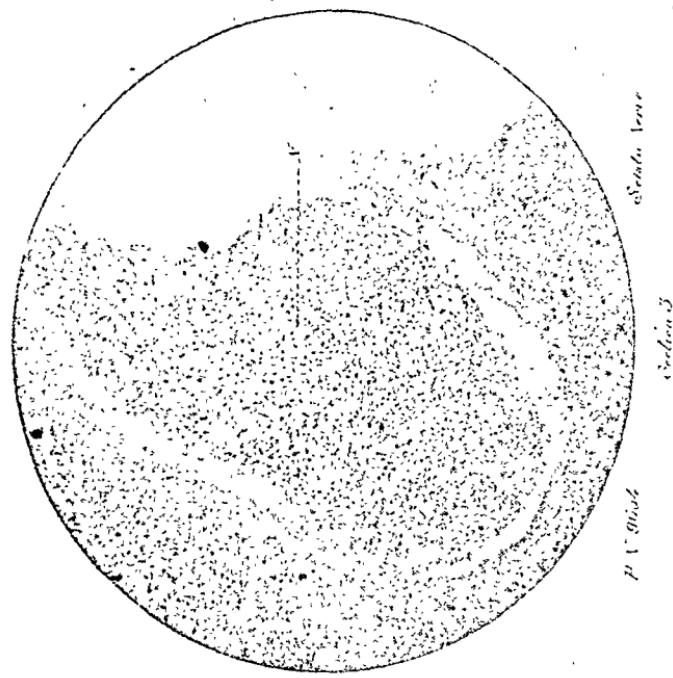
Degeneration of nerve fibre with definite infiltration of tumor cells. Compare this nerve fibre with those shown in Sections 1 and 6

malignant neuroma in contradistinction to primary sarcoma or glioma developing in nerves.

PATHOLOGICAL REPORT.

BY DR. J. C. BLOODGOOD.

The tumor of the sciatic nerve sent by Dr. Mackenzie for examination has been recorded in the surgical pathological laboratory of the Johns Hopkins Medical School and Hospital under the number 9654.

The tumor is malignant—a sarcoma. The sarcoma belongs to that variety which arises from the fixed connective-tissue cells, and in this case it undoubtedly originated in the perineural connective tissue. It is chiefly a spindle-cell sarcoma, but there are areas in which there is a great deal of fibrous tissue. Photomicrograph, Sect. 4b (Fig. 8), pictures the cellular portion of the tumor, and photomicrograph, Sect. 4a (Fig. 9), stained with Mallory and Wright connective-tissue stain, illustrates a portion of the tumor in which fibrous tissue is in excess.

. I am not prepared as yet to give a full report on degeneration of the nerve-fibres. In photograph, Sect. 1 (Fig. 10), the nerve above the tumor, as compared with photomicrograph, Sect. 6 (Fig. 11), the nerve below the tumor, one can see that some nerves pass through without degeneration. For this reason I would expect that the patient did not have complete loss of nerve-function; that some of the nerve-bundles were completely degenerated is shown in photomicrograph Sect. 3 (Fig. 13). This was taken from below the gross tumor and shows a nerve-bundle in which it is impossible to make out, except here and there, an axis cylinder and sheath. The perineurial connective tissue still confines the nerve fibre, but the endoneurial connective tissue is practically replaced by tumor cells and degenerated tissue.

The gross appearance of the tumor is shown in the photograph by Mr. Schapiro (Fig. 7). The tumor proper is situated in the sheath of the sciatic nerve; it has pushed the nerve aside and excavated for itself a bed. The tumor is therefore of perineural origin. In the tumor proper I can make out no gross or microscopic evidence of nerve-fibres. This tumor (Sects. 4 and 5) is a fibro-spindle-cell fibrosarcoma, illustrated in photomicrographs, Sects. 4a and 4b. The growth, however, not only produces pressure upon the nerve, but there is direct infiltration into the nerve itself by tumor cells. However, both in the gross and microscopic section, it seems to me that I can trace nerve-bundles through. They apparently lie anterior, if I am correct in assuming that the tumor was posterior. When a section is made through at about the level of Sect. 4 (Fig. 2) the tumor can be seen with a semilunar-shaped nerve-trunk to the anterior side. That some of the nerve-bundles are degenerated is shown from photomicrograph, Sect. 3, taken from the nerve-trunk proper just anterior to the tumor.

Both in Sect. 1 and in Sect. 6, illustrated in the photomicrographs of this number, and in Sect. 2, not illustrated, we see a cellular myxomatous tissue (Mx) which probably represents the so-called "Anlage" or rudi-

ment of the tumor. In photomicrograph 6b (Fig. 12) we have a high power of one of these areas.

The lower end of the nerve, Sect. 6, is considerably larger than the upper end (Sect. 1). This is due apparently to hypertrophy of the epineural connective tissue shown in Sect. 6, and an enlargement of the nerve-fibre within the perineurium, and this enlargement seems to be due to increase in the endoneurial connective tissue.

For this tumor resection was undoubtedly the only procedure that promised any hope of a permanent cure. The tumor also belongs to that large group of simple sarcomata in which cures are generally accomplished. The histology of this tumor corresponds with two observations of my own which have remained well, one six years and one three years after operation, but in another case in which the position and histology of the tumor somewhat resembled the position and histology of the tumor in your case, the patient had a free interval, first of seven months after resection, and then a second free interval of four years after amputation for recurrence.

The histological evidence of the "Anlage" (see 6b) of the tumor in the sections taken from the upper and lower end of the nerve, I fear, must be looked upon as evidence suggesting a possible recurrence, but I do not think we know as yet enough about tumors of nerves to be absolutely certain as to this point.

REFERENCES.

Ballance and Stewart: "The Healing of Nerves," London, 1901.

Bowlby: "Injuries of Nerves," Lancet, July 26, 1902.

Head, Rivers, and Sherren: "The Afferent Nervous System from a New Aspect," Brain, Part ii, November, 1905.

Horsley, Victor: "On Injuries to Peripheral Nerves," Practitioner, August, 1899.

Killvington, Basil: "Investigation of the Regeneration of Nerves," British Medical Journal, April 29, 1905.

Létiévant: "Traité des Sections Nerveuses," Paris, 1873.

Lexer—Bevan: "Neurofibromatosis," System of Surgery.

Murphy, John B.: "Neurological Surgery," Surgery, Gynæcology, and Obstetrics, vol. iv, No. 4, April, 1907.

Powers, C. A.: "Bridging of Nerve Defects," ANNALS OF SURGERY, November, 1904.

Rivers and Head: "A Human Experiment in Nerve Division," Brain, Part iii, November, 1908.

Sherren, James: "Secondary Suture of the Great Sciatic Nerve," British Medical Journal, Feb. 16, 1907.

Sherrington: "On the Anatomical Constitution of Nerves of Skeletal Muscles," Journal of Physiology, 1894-'95, vol. xvii, p. 211.

Spitzy, Hans: "Technique of Neuroplasty," American Journal of Orthopedic Surgery, August, 1904.

Taylor, R. Tunstall: "Operative Treatment of Infantile Paralysis, with Special Reference to Neuroplasty," New York Medical Journal, July 7, 1906.

OBSERVATIONS ON THE INEQUALITIES OF THE RIGHT AND LEFT FEMORA.*

BY ALGERNON T. BRISTOW, M.D.,

OF BROOKLYN, NEW YORK,

Surgeon to the Long Island College, Kings County and St. John's Hospitals.

THE opening sentences of the second chapter of Darwin's "Descent of Man" are as follows:

"It is manifest that man is now subject to much variability. No two individuals of the same race are quite alike. We may compare millions of faces and each will be distinct. There is an equally great amount of diversity in the proportions and dimensions of the various parts of the body, the length of the legs being one of the most variable points."

The late Dr. Jarvis S. Wight, in two valuable papers written in 1877 and 1878, called attention to the inequalities of the lower limbs, which occur normally,—that is to say, in case where no fracture has ever occurred,—and he pointed out the importance of recognizing this fact in the treatment of fractures, not only from a practical but also from a medicolegal standpoint. The first paper of Dr. Wight was published in the *Archives of Clinical Surgery*, vol. i, No. 8, February, 1877, and the second paper appeared in the "Proceedings of the Medical Society of the County of Kings," January 21, 1878.

In the first paper, which was in effect a report of a clinical lecture, Dr. Wight, after rehearsing the fact that experts differ in their measurements of limbs, and that one expert will sometimes have various differences after several comparative measures of the two limbs, states that it occurred to him to make a number of measurements of the lower limbs of those who have never had the femur broken. These measurements were all made from the anterior superior spine of the ilium to the lower

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extremity of the internal malleolus, with the figures of the tape line down, so as to be invisible. Dr. Wight thus measured 60 individuals; in only ten out of the 60 cases were the lengths of the two lower extremities equal. We may tabulate his results as follows:

Cases	Variation of limbs
10	no
4	⅛ inch
25	¼ inch
13	½ inch
4	⅜ inch
1	⅝ inch
1	⅞ inch
1	1 inch
1	1⅜ inch

In considering the importance of these differences we may certainly exclude the four cases in which the difference was but ⅛ of an inch and the 25 cases in which the difference was but ¼ of an inch as of no practical importance. Not so, however, with the remaining 21 cases, being more than 34 per cent. of the whole number measured. In these 21 cases in which the variation exceeded ¼ inch, there were 4 of ⅜ inch; 13 of ½ inch, and one each respectively of ⅝ and ⅞ inch, one inch and one inch and three-eighths variation, and this in individuals who had never been the subject of fracture.

Dr. Wight very justly observes, in view of these figures, that to assume in cases of fractured femur that the two femora were usually of the same length, might involve an error of more or less gravity. In fact in the series in question, taken at random, 10 only out of 60 cases had lower extremities of equal length. Dr. Wight also quotes an article by Dr. W. C. Cox, *Am. Jour. Med. Sciences*, April, 1875, where the reporter states that after accurately measuring the normal lower limbs of 54 individuals there were 15 cases which showed a difference of ½ inch or more, the greatest difference being ⅞ inch.

In November of 1877 Dr. F. H. Hamilton (*Hospital Gazette and Archives of Clinical Surgery*) ridiculed the claims of

Dr. Wight concerning the frequency of inequality in the lower limbs, and January 21, 1890, at a meeting of the Medical Society of the County of Kings, Dr. Wight replied to him by citing the results of 42 measurements in a new series of cases. In this series there were 13 cases in which the normal lower limbs were of equal length and 29 cases in which inequalities existed. Tabulated as follows:

Difference	Number of cases
⅛	1
¼	14
⅜	5
½	4
⅝	3

Combining the two tables of Dr. Wight the left lower limb was the longest in 52 cases, the right in 27 cases. In 26 cases there was a difference of half an inch or more and in 9 cases the difference was over half an inch. The brief controversy between Dr. Wight and Dr. Hamilton was ended by a letter from the latter to the former, in which he states that after a dozen measurements made with great care by himself and his house surgeon, a large majority were of unequal length, the left being generally the longest, and he acknowledged the correctness of Dr. Wight's position.

It is somewhat strange that this matter of the inequality of the lower limbs with its bearing on the question of fractures of the femur has received so little attention in the text-books. In " Gray's Anatomy " a brief footnote simply refers to the claims of Dr. Wight. The matter seemed of sufficient importance to the writer, however, to merit further investigation, and as Dr. Wight's papers had no dissecting-room data, it seemed wise to have actual measurements of disarticulated bones in order to determine beyond the possibility of a doubt whether Dr. Wight's claims could be substantiated. The actual bone measurements were chosen because it is evident that whatever divergence might exist between different observers when measuring from the anterior superior spine to the lowest point of internal malleolus, no such divergence was

possible in laboratory measurements of companion bones. The humeri were also examined and compared in order to determine the truth of Dr. Wight's claims that when the femora were unequal the humeri were also unequal, the inequality being hemilateral. It is evident, of course, that in cases of fracture of the femur, if this be a fact, that the measurement of the humeri in the same individual would indicate whether the femora were originally equal, and if not, which side was originally the longest.

The writer desires to submit tables of measurements of 124 cases, in all of which measurements of paired humeri and paired femora were made. One series of cases of 54 were measured in the anatomical laboratory at Columbia University. Another series of cases, 50 in number, were measured in the anatomical laboratory at the University and Bellevue Medical School, and a small series of 20 cases from other sources were made by my assistants, Drs. E. H. Fiske and R. M. Rome. I wish to acknowledge the great courtesy offered me at the anatomical laboratory at Columbia University and also the University and Bellevue Medical School. I am indebted to Dr. Fred. Tilney, associate in anatomy, for the measurements made at Columbia, and to Dr. W. C. Cramp for the measurements made in the University and Bellevue Medical School. The work was laborious and time consuming, and I deeply appreciate the invaluable assistance of the gentlemen who so kindly rendered it possible for me to write this paper.

I submit first the tabulation of measurements made by the Department of Anatomy, Columbia University. The measurements are in centimetres. The entire bone was measured at Columbia with an apparatus similar to the familiar shoemaker's rule with sliding arm. At Bellevue the measurements were taken from the tip of the great trochanter of the femur to the external condyle. The Columbia measurements were made on 54 subjects. The University and Bellevue on 50 cases.

The Long Island cases were 24 in number, making a total of 128 subjects, a total of 512 measurements.

TABLE I.—Columbia University, Department of Anatomy.

No. of Subject	Humerus R	Humerus L	Femur R	Femur L	No. of Subject	Humerus R	Humerus L	Femur R	Femur L
1805	31.6	31.4	43.	43	2096	34.1	33.8	45.4	46.1
1812	31.2	31.6	42	42.4	2001	34.4	33.8	45.4	45.1
1778	33.4	34.	48	47.8	2042	31.2	31.4	43.6	43.6
1752	34.8	34.6	47.8	47.4	2023	33.2	33.4	47.8	47.6
1762	31.8	31.4	43	42.4	2061	34.4	34.2	46.1	45.8
1768	32.2	32.2	45.8	46	2005	34.1	33.6	44.8	45
1790	33	32.2	45.8	46	2085	32	32	45.1	44.8
1798	33.8	33.4	48.6	48.4	2013	35.	35.1	47.4	48.1
1774	32.6	32.2	44.8	44.4	2044	33	32.4	44.2	44.6
1757	32.8	32.1	46.4	46.	2088	32.8	32.9	43.	43.
1785	34.	34.	46.8	47.4	2098	35.	34.8	51.8	51.6
1766	31.4	31.4	45.4	45.4	7A	32.4	32.4	45.4	46.4
1755	34.1	34.	48.	47.1	2008	29.6	29.1	42.	41.8
1694	32.	32.4	46	46.	1759	33.	32.8	44.	43.8
1816	32.4	32.	45.	45.2	2089	31.8	30.8	44.	44.
1782	31.2	31.1	44.2	44.2	2068	34.1	33.8	47.1	47.2
1784	32.4	32.8	45.4	45.6	2079	34.6	33.	43.2	43.2
1815	34.	34.1	48.8	49.1	18A	34.	33.1	47.6	47.2
1799	31.8	31.8	43.6	44.	2060	32.8	32.	46.6	45.9
1743	32.2	32.2	43.2	43.	2070	31.1	31.4	42.6	42.8
1760	31.8	32.6	42.2	43.	2075	33.8	33.	48.6	48.
1818	31.2	31.	43.4	43.4	2086	27.4	27.2	38.	38.
1767	31.4	31.2	43.	43.	124	34.5	34.8	46.	46.
57	32.2	32.	43.	43.	102	33.4	32.9	47.	46.5
55	32.	32.4	44.4	45.2	54	31.4	31.2	43.	43.4
50	32.9	32.2	45.	44.	118	30.8	31.	43.	43.2
64	33.4	32.2	46.1	46.6	105	32.4	31.5	43.8	44.4

Review and analysis of Table I bring out the following facts:

First, that the length of the human femur and humerus varies in such a way as to make possible a division into four classes upon this basis, as follows:

Class I.—Femurs equal, humeri equal in same subject. Frequency, 1.8 per cent. Reference, Case No. 1766.

Class II.—Femurs equal, humeri unequal. Frequency, 22.2 per cent. References, Cases No. 1805, 1694, 1782, 1818, 1768, 57, 2042, 2088, 2070, 2079, 2086, 124.

Class III.—Femurs unequal, humeri equal. Frequency, 11.1 per cent. References, Cases No. 1768, 1785, 1799, 1743, 2085, 7a.

Class IV.—Femurs unequal, humeri unequal. In this class two types to be distinguished, *i.e.*, Type A: Greater length of homolateral humerus and femur; Type B: Greater length of contralateral humerus and femur. Frequency, 64.8 per cent. References: Type A, Cases Nos. 1812, 1752, 1762, 1790, 1798, 1774, 1757, 1755, 1816, 1784, 1815, 1760, 55, 50, 64, 2001, 2061, 2005, 2013, 2098, 2008, 1759, 18a, 2060, 2070, 2075, 102, 118. Type B, Cases Nos. 1778, 2090, 2023, 2044, 2068, 54, 105.

Second, that in the subjects presenting inequality of the humeri, the greater length was observed on the right side in 34 cases as against 11 on the left side, while the cases which showed inequality in the femurs were 19 on the right side having the greater length as against 18 on the left side.

Third, that in cases in which the right humerus was longer than the left, the maximum difference between the two sides was 12 mm., whereas in those cases in which the left humerus was longer than the right the maximum difference observed was 4 mm.

TABLE II.—University and Bellevue Medical School, Department of Anatomy.

No. of Subject	Humerus		Femur		No. of Subject	Humerus		Femur	
	R	L	R	L		R	L	R	L
1	31.	31.	38.5	39.	26	36.75	36.5	52.5	53.
2	31.5	31.5	39.	39.25	27	33	33	44	44.25
3	34.	34	44.25	44.5	28	32.5	32.5	43	42.75
4	32.5	32.5	45	45	29	37	37.25	45	45.5
5	35.5	35.5	48.5	48.5	30	33	33	44.5	44.5
6	29.5	29.75	38.5	38.75	31	32	32	45	45
7	29.5	29.5	40.5	40.5	32	31.5	31	41.5	41.5
8	31	31	41	41	33	29.5	29.5	38.5	38.5
9	28.25	27.75	41	40.5	34	32	32	44	44
10	32.5	32.5	40	40.25	35	32	32.5	46	46.5
11	31.5	31.5	40.5	40.75	36	31.5	31.25	42.5	42
12	30.25	30.5	42	42.	37	33.5	33.5	45.3	45.5
13	34.5	34.5	41	41	38	30.75	30.5	42.5	42.5
14	32	32.5	42	42.25	39	36	36.25	46.25	46
15	32	32	42.5	42	40	32.25	32	43	42.5
16	31.75	32	43.5	43	41	31.5	31.25	44.25	44
17	31.5	31	41	41	42	33.	33.	45	45.5
18	29.5	29.5	46.25	46.25	43	33.5	33.5	44.75	44.75
19	32.5	32.25	43.5	43.5	44	31.	31.	44.25	44
20	34.5	34.25	44.25	44.5	45	31.5	32	43.5	43.75
21	30.5	30.5	40.5	40	46	34	33.5	45	45.5
22	32.	32.	43.5	44	47	31.5	31.5	44	44.25
23	34	34	46	46.25	48	38	37.5	40	39.5
24	31.5	31.5	41.5	41.5	49	32.5	32.5	45.5	46.5
25	28.25	28.5	41.25	42.25	50	33.75	33.5	48	47.75

Fourth, that in cases in which the right femur was longer than the left, the maximum difference observed was 9 mm.; while in cases in which the left was longer than the right the maximum difference was 10 mm.

Fifth, that the mean excess in length of the right humerus over the left was 4.9 mm. and that of the left over the right was 2.6 mm.; while the mean excess in length of the right femur over the left was 4.2 mm. and that of the left over the right was 4.7 mm.

The tabulated series of 50 cases obtained from the Anatomical laboratory of University and Bellevue is given in Table II.

Class I.—Femurs equal, humeri equal in same subject in Nos. 4, 5, 7, 8, 13, 18, 19, 24, 25, 30, 31, 33, 34, 43, fourteen cases in all. Frequency 28 per cent.

Class II.—Femurs equal, humeri unequal, Nos. 12, 17, 19, 25, 32, 38, six cases. Frequency 12 per cent.

Class III.—Femurs unequal, humeri equal, Nos. 1, 2, 3, 10, 11, 15, 21, 22, 23, 27, 28, 37, 44, 47, 49, 42, sixteen cases. Frequency 32 per cent.

Class IV.—Femurs unequal, humeri unequal. Type A: Greater length of homolateral humerus and femur. Cases 6, 16, 29, 35, 36, 40, 41, 45, 48, nine cases. Frequency 18 per cent. Type B: Contralateral cases, Nos. 9, 20, 26, 39, 46, five cases. Frequency 10 per cent. Total 28 per cent.

Unequal humeri: Right longest in 13 cases; left longest in 8 cases.

Unequal femora: Right longest in 12 cases; left longest in 20 cases.

Mean difference, humeri, 3.3 mm.; mean difference, femora, 3.8 mm.

Maximum difference, humeri, 5 mm.; maximum difference, femora, 1 cm.

TABLE III.—Long Island Hospital.

No. of Subject	Humerus		Femur		No. of Subject	Humerus		Femur	
	R	L	R	L		R	L	R	L
1	31.5	31	45.5	45	13	37	37	43.5	43
2	34	34	46	46	14	33	33	43	43
3	27	27	38	38	15	33	34	43	43
4	33	33	49	49	16	31	30.5	42	42.5
5	33.5	34	43.5	44	17	31	31	40	40.25
6	35	34.5	45	44.5	18	24	23.75	42.5	42
7	34.5	34.5	45.5	45.5	19	34	34	45	45.25
8	30.5	30.5	41	41	20	35.25	35	42	41.75
9	30	30.5	39.5	39	21	31.5	31.5	43	43
10	30	30	42	41	22	20	29.75	39	40.5
11	32	31	44.5	45.5	23	30	30	43	43
12	32	32	42	43	24	27.75	27	37.25	36.5

The Long Island cases were measured in a manner similar to that employed at Columbia, a rule with sliding arm being used. The series may be analyzed as follows:

Class I.—Femurs equal, humeri equal, Nos. 3, 9, 15, 2, 4, 8, 16, 22; eight cases. Frequency 33 per cent.

Class II.—Femurs equal, humeri unequal; one case, No. 15. Frequency 4 per cent.

Class III.—Femurs unequal, humeri equal, Nos. 11, 13, 23, 14, 18, 20; five cases. Frequency 22 per cent.

Class IV.—Femurs unequal, humeri, unequal. Type A: Greater length of homolateral humerus and femur, seven cases. Reference, 1, 5, 6, 7, 19, 21, 23, 25. Type B: Greater length of contralateral humerus and femur, three cases. Reference, 10, 12, 17.

Inequality of Humeri.—The right was longest in 8 cases, and the left was longest in 4 cases.

Inequality of Femurs.—The right was longest in 8 cases and the left longest in 6 cases.

When the right humerus was longest the mean difference was 1 centimetre, and when the left humerus was longest the maximum difference was 1 centimetre. The left humerus the same. The right humerus being longest, the mean difference was 5.9 mm., and 7.5 mm. when the left was in excess. The mean difference when the right femur was the longest was 5.6 mm., and when the left was in excess 7 mm. Maximum humerus, 1 cm.; maximum femur, 1 cm.

A summary of the three series is as follows in percentages: Femurs equal, humeri equal, Columbia, 1.8 per cent.; Bellevue, 28 per cent.; Long Island, 33 per cent. It thus appears that the highest percentage in which we could expect symmetry of the extremities is 33 per cent.

In Class II, in which the humeri were unequal but the femurs equal, the Columbia percentage was 22.2 per cent., Bellevue 12 per cent., and Long Island 4 per cent.; therefore in about 20 per cent. of the cases unequal humeri would be accompanied by equal femurs, and Dr. Wight's rule would therefore not apply.

In Class III, where the femurs were unequal and the humeri were equal, the percentages were as follows: Columbia

11.1 per cent., Bellevue 32 per cent., Long Island 22 per cent.; that is to say, although the femurs were unequal, the humeri would be equal in about 22 per cent. of these cases, so that again Dr. Wight's rule of comparison of. humerus with companion femur would be fallacious. Taking the two classes together, Class II and Class III, and the rule would not apply in at least 40 per cent. of the cases.

In Class IV, in which both upper and lower extremities were unequal, the percentages were: Columbia 64.8 per cent., Bellevue 28 per cent., Long Island 44 per cent., giving an average of 45.6 per cent., in which both upper and lower limbs were asymmetrical.

In the whole series of cases the right humerus was longest in 55 cases, and the left in 23 cases. This preponderance of length of the right over the left humerus may readily be accounted for by righthandedness. Correspondingly, the right femur was longest in 39 cases, the left femur in 44 cases. This does not entirely agree with Dr. Wight's conclusions that the left femur is the longest where inequalities exist in so large a proportion of cases as his measurements on the living subject indicates; still in this series of carefully measured cases, the left femur is longer than the right in 44 out of 83 cases. The companion tibiæ were unfortunately not measured; but from a comparison of these figures it is quite probable that where one femur was longer than another the corresponding tibia was also longer,—and if we assume that the maximum and mean differences of the tibiæ were proportionate to the femoral differences, the total inequality of the lower limbs would be nearly double the inequalities of the femora alone. The average maximum difference of the three series where the humeri were longer was 7.2 mm., about three-quarters of a centimetre, and the mean difference, 6.5 mm. Where the femurs were unequal, the average maximum difference was 9.8 mm., and the average difference 8.6 mm.

One hundred and twenty-eight cases were measured in the entire series, and in 99 of these cases the femora were unequal.

It therefore appears that symmetry of the femora in the same individual is exceptional and that asymmetry is the rule. At least in 78 per cent. of the cases recorded, asymmetry existed, and in cases of asymmetry the average disproportion in length of the femur alone as measured on actual specimens of bones was very nearly 1 cm., and if we add a variation in the companion tibiæ of but ½ cm., the total variation on the ordinary surgical measurements would be not far from 1½ cm. It may readily be seen, therefore, that if the short bone were fractured the apparent shortening would be very much greater than the actual shortening, and if sufficient weights were put on the injured limb to make the femora equal, something that they were not originally, the ends of the bones might be actually separated by a distance which might lead to non-union. The best method of preventing such an untoward circumstance at present seems to be in the routine employment of the Röntgen photograph, for there seem to be so many sources of error possible in using sound bones in the same individual as a means of comparison, that no fair deduction could be drawn therefrom. The present methods of measuring the lower extremities are unsatisfactory in the extreme. The anterior superior spine, except in very lean individuals, is a very uncertain quantity, and no two men are likely to agree on what is the lowest point of the internal malleolus. The umbilicus has been discredited as a point from which to measure, but it has occurred to the author that possibly the sternal notch might be available, the lower point of measurement being the plane of the heel in line with the internal malleolus, this plane being determined by the apposition of any plane surface to the foot. The upper end of the tape is fixed at the sternal notch and not moved for the measurement of either side, the lower end of the tape being swung first to the plane of the right heel and then to the plane of the left. In order to determine which of the three methods was least open to individual error, my assistants, Drs. E. B. Fiske and Russell W. Rome, made a series of 312 measurements of paired femora in 52 male subjects, neither being aware of the figures obtained by the other.

These measurements were most carefully made with the following results: (1) The average variation between the measurements made by the two men, anterior superior spine to malleolus, was 1.07 cm. (2) In measuring from the umbilicus to a plane surface in apposition with the plane of the heel the average variation was 1.24 cm. (3) In measuring from sternal notch to plane of heel, the average variation was 1.10 cm. (4) The smallest variation was from sternal notch to right femora, being a mean of 1.04 cm. The greatest variation was on the left side, umbilical measurement, 1.27 cm. (5) In 312 measurements there was exact agreement in only 40 cases, a little over 12 per cent. of all cases measured.

It is my impression that the measurement taken from the sternal notch to the plane of the heel, as indicated by a plane surface in apposition therewith, will prove to be a method least open to error. The following precaution, however, must be adopted. The measurements must be made at the same period of respiration. The plane surface in apposition with the heel must be parallel in each case, as a slight inclination in either direction would mean an error in the measurements.

THE TRANSPORTATION OF SKIN FLAPS FROM ONE PART OF THE BODY TO ANOTHER AND FROM ONE INDIVIDUAL TO ANOTHER.*

BY JOHN M. T. FINNEY, M.D.,

OF BALTIMORE, MD.,

Associate in Surgery in the Johns Hopkins Hospital.

AMONG the most ancient and best known surgical procedures which have been handed down to us are the classical methods of repairing defects in the integument by means of the transference of portions thereof from one part of the body to another. These methods are so familiar that a discussion of them at this time would be not only out of place, but foreign to the purpose of this paper. We will limit ourselves, therefore, to a consideration of those methods alone which have to do with a transfer of skin flaps from one part of the body to another, without the preservation of the original blood supply to those flaps. We shall also exclude from consideration those methods which deal only with the skin itself, in whole thickness or in part, such as the well-known procedures of Reverdin, Thiersch, Wolff-Kraus, etc. We wish to consider that class of case in which it is desirable, in order to repair losses of substance, to transplant something more than the skin, e.g., the subcutaneous fat, fascia, periosteum, etc., as the case may be. Obviously the range of applicability of these latter methods is limited, as the advisability of retaining the original blood supply where possible is so apparent as to need no further comment. Now and then, however, a case presents itself for relief, in which owing to the particular location, or to such extensive losses of substance from trauma of one sort or another, chiefly scalds or burns, that it is impossible to make use of the older methods, because of lack of sufficient or suitable tissue in the immediate neighborhood of the part to be restored.

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* Read before the American Surgical Association, June 5, 1909.

Such a condition was present in the person of Roberta M., a girl of seven, who was referred to me by Dr. Rees of Charleston, South Carolina. In this case, owing to extensive burns involving the upper anterior portion of the body, the chin was drawn down upon the chest, and the lower part of the face frightfully scarred and disfigured. The lower lip was entirely missing, except for the mucous membrane which was everted, exposing the lower teeth and gums. Saliva was continually drooling from the mouth. The front of the neck, chest and upper extremities were covered with dense cicatrices which rendered it manifestly impossible to obtain suitable skin flaps from anywhere in the vicinity. In our extremity, we finally hit upon the following plan as the only one which seemed at all feasible.

FIG. 1.
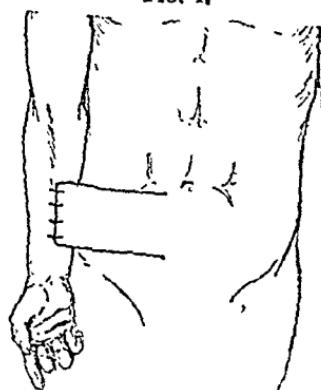
Transporting the skin and subcutaneous tissue from the abdomen to the forearm.

A flap six by four inches, with its base toward the middle line was dissected up from the anterior surface of the abdomen. This flap included the skin and subcutaneous tissue down to the aponeurosis of the rectus and external oblique muscles. An incision four inches long was then made upon the anterior surface of the forearm. The free border of the abdominal flap was inserted into this incision and the skin edges carefully united. Gutta-percha tissue was placed over the denuded surface of the abdomen after the edges had been approximated as closely as possible by other silk sutures. The arm was fixed to the patient's side with a broad strip of adhesive plaster, passed around the arm of the patient and then around her body. The arm was left in this position for two weeks. The dressing was then removed and the circulation in the flap found to be good through-

. out. The pedicle of the flap was now divided, severing it from its abdominal attachment. The arm was then flexed and the patient's hand brought up to and placed upon her head, allowing the free end of the flap to be adjusted to the cheek, which had been freshly denuded for this purpose, after reflecting upward the flap of everted mucous membrane. The skin flap, now receiving its blood supply from the forearm, was fixed in place by sutures between its free border and the skin of the cheek and left in place for another two weeks. At the end of this time, the circulation having become established between the cheek and the flap, its attachment to the forearm was severed, and the repair

FIG. 2.
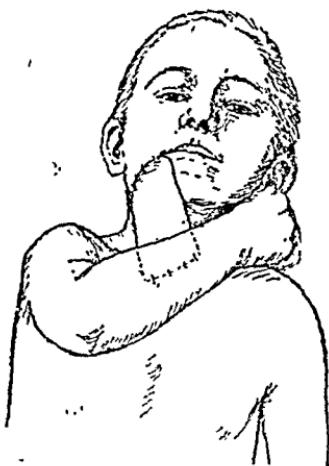
Transporting the flap from the forearm to the cheek.

of the lower lip completed by attaching the mucous membrane to the upper free border of the abdominal flap which now composed the lower lip. A few sutures were placed in the lower edge of the flap attaching it to the skin of the neck. Care was taken to avoid any tension or any more interference with the circulation than was possible. A slight sloughing of the flap occurred at one corner but not enough to affect materially the result, which in the end was most satisfactory. Massage of the new lip was begun as early as the healing would allow, and aided much in loosening up the surrounding tissues.

I had occasion to make use of this same procedure in another case very similar to the one just reported. This patient, a child of four and one-half years, had been severely

burned about the lower part of the face and upper part of the body in front, and presented a condition almost identical with the case just reported. Exactly the same procedure was carried out. Here, however, the result was not so satisfactory owing to the youth and extreme restlessness of the child. Considerable sloughing of the corners of the flap occurred, although the central portion ,took nicely and materially improved the patient's appearance. Our experience with this second case and a subsequent one to be referred to later, leads us to believe that such operative procedures as these requiring fixation of the parts, are not applicable to young children.

FIG. 3.

The flap fixed in its final place, restoring lower lip and covering chin.

Extreme youth, therefore, we would regard as a definite contra-indication to these operations.

In looking over the literature of the subject, the only references I can find to similar operations are as follows:

In 1888 Dr. G. F. SHRADY of New York, in a personal communication to Sir W. McCormick and reported by him, gives an account of a very ingenious method by which he was able to cover up a "most unsightly gap in a girl's cheek. The arms are folded in a comfortable manner. A suitable-sized flap is dissected up from the anterior surface of the arm with its base either up or down, as desired, and the free end of the flap is stitched into a slit made for the purpose in the radial side of the forefinger. Later the flap is cut loose from the arm and then transported by the finger to the desired locality. This case resulted very satisfactorily."

So far as I am aware, this case was never published elsewhere by Dr. Shrady.

In 1895 Dr. W. S. Halsted reported to the Johns Hopkins Hospital Medical Society a method which he had made use of in a patient suffering from extensive burns over the chest, neck, and arms, in whom he had transferred a skin flap from the back and side of the neck around to the front. Dr. Halsted characterized his method as a " waltzing " of flaps and described it as follows: " None of the original attachments of the last flap which we used have been preserved. The flap has twice been twisted upon itself, first upon a small pedicle of skin (original tissue we may call it), and secondly upon a little broader pedicle of cultivated cicatricial tissue. The flap has probably made a complete revolution."

The result in Dr. Halsted's case was most satisfactory.

In 1901 STEINTHAL reported an operation almost identical with the one performed by us. The operation in his case was done "to relieve a very extensive loss of skin from the face which had been excised to relieve an extraordinarily progressive lupus. Attempts had previously been made by means of the Thiersch method to relieve the deformity. The results, however, were not satisfactory. The greater portion of the nose had been destroyed and it was necessary to do a complete rhinoplasty. The surrounding skin being useless for this purpose, it was necessary to secure a flap from elsewhere." In order to do this, Steinthal cut from over the sternum "a tongue-shaped skin-periosteal flap of suitable size. After cutting and preparing the flap, the breast wound was almost closed with sutures, and the broad edge of the flap grafted into the forearm through a corresponding incision made over the lower end of the radius. The flap was sutured into place, and the arm fastened in a comfortable position by a bandage. The flap was kept from drying out by a thick boric ointment dressing. Four days later the nourishment bridge on the breast was cut through. A few days later the flap, being at this time well nourished, was attached to the root of the nose and the arm fixed against the head in a comparatively comfortable position, with plaster of Paris bandages. After ten days, the flap was separated from the arm and a new nose made from the hanging flap, which was now luxuriantly granulating. The result was most satisfactory, some trimming up of the flaps being necessary later."

These reported cases demonstrate beyond doubt the feasibility of the method and establish the principle that in selected cases where for one reason or another it is impossible to secure flaps in some one of the usual well recognized methods, use may be made of this principle with a fair prospect of success.

In rare instances, however, the conditions may be such that it is impossible to make use even of this method which has just been described. In such cases where one cannot secure suitable flaps from the patient himself, one is forced to look elsewhere, namely, to the person of another. Such a case presented itself to the writer since the first portion of this paper was written.

The patient was a girl 5 years of age, also from Charleston, South Carolina, who came to me through the satisfactory result obtained in the first case just reported. This child had been run over by a street car some months previously. The right leg had been so badly injured as to necessitate amputation at about the middle of the thigh. The left foot also had been badly crushed and the integument of the foot had sloughed off, leaving the foot entirely devoid of skin up to the malleoli. The child who, at the time of the accident had been in robust health, was now, owing to the accident and resulting disturbances, much reduced. Attempts had been made by her physician to cover the foot with Thiersch grafts, but unsuccessfully. These grafts had been cheerfully given by an older sister of the patient, and had been cut from her thigh.

Owing to the poor condition of the patient, and the fact that one leg had been lost, and that there was no possible chance of securing flaps from the other, nor, indeed from any other portion of the patient's body, it was decided to attempt the direct transplantation of skin flaps from another person. The idea was proposed and the same sister who had previously given the Thiersch grafts volunteered to supply the other. The method of procedure was as follows Under ether, a flap, seven by five inches, consisting of skin and subcutaneous fat and having its base upward, was raised from the outer surface of the donor's thigh. The patient's foot which had been freshly denuded for the purpose was inserted between the flap and the raw surface left after it had been dissected up. The flap was large enough to cover completely the plantar surface of the foot and was held in position by stitches through its free border and the edge of the skin above the patient's heel. A few interrupted sutures were placed on either side, wrapping, as it were, the flap around the denuded sole of the foot of the patient. Patient and donor were

held in this position by adhesive strapping and plaster of Paris bandages, holding the legs of the two in apposition and parallel to each other, with their heads in opposite directions. They were put to bed with the head of one at the head of the bed, and the head of the other at the foot. The two were surprisingly comfortable, and I feel sure the flap would have taken well, had it not been necessary, owing to the extreme restlessness of the patient, who as was said before, was only five years of age, to cut them apart earlier than had been intended. She was a spoiled child and wilfully added to the pain and discomfort of her older sister by moving her foot as much as possible when she felt so disposed. The two were kept tightly bound together in this fashion for ten days. I did not feel justified in keeping them together longer, owing to the needless pain inflicted by the patient upon her sister, who bore it most heroically. At this time the circulation in the flap appeared excellent, except at the very tip, and it had firmly adhered to the foot of the patient. Upon dividing its pedicle, however, after a few days the circulation began to show signs of failing, and the flap softened and soon completely disappeared.

Here again, as has been previously noted in the beginning of this paper, owing to the extreme youth and restlessness of the patient, the operation was prevented from being a success. The idea, however, I believe to be perfectly feasible and, under proper conditions, capable of being carried to a successful issue. I had supposed that this was a unique case, as no reference in the literature could be found to any similar one. We did find, however, that in 1865 Hamilton had suggested the possibility of such a thing, and had actually proposed it in one case, but no one could be found who would furnish the necessary tissue. A personal communication from Dr. F. B. Lund, of Boston, accompanied by a photograph reports a similar case performed by him in August, 1908. I quote as follows:

Michael M., aged 19 years, single, had his foot caught in an elevator, so that the entire sole of the foot was crushed off. He was admitted to the City Hospital on August 4 and on August 25 had a perfectly clean granulating area covering the entire sole of the foot from the base of the toes to the tip of the heel. He had a fairly large foot, and it seemed to me that if a sufficiently large flap were taken from the other leg it would

Fig. 4

Case I.—Showing result after operation.

denude it too much, so the experiment was tried of taking a flap from the abdomen of his brother, who was about his age and size. The brother was placed in a bed which was brought up to the foot of Michael's bed, so that the sole of Michael's foot lay across his brother's abdomen. On August 25 they were both etherized, Michael's foot was curetted and a flap turned up from his brother's abdomen below the umbilicus, the long axis being transverse, of course, to the body. The flap was sutured to the inner side and posterior and anterior borders of the raw surface on Michael's foot. Then the brother was bolstered up and confined by straps attached to the bed in various directions with a sheet across him, and Michael's foot was tied down so that he could hardly move it. The use of plaster of Paris was thought of; but it presented some difficulties, so the idea was abandoned.

When the boys came out of ether, they began to be very uncomfortable and used language of the most violent kind toward each other, and almost came to blows. The following day, the brother had a temperature of 103, rapid respiration and signs of consolidation at the base of one lung. He was very uncomfortable in his position, and the question of cutting them apart was considered, but it was decided to leave them together. The foot was dressed two days after the operation, and looked healthy. The brother from whom the abdominal flap had been taken was very uncomfortable and hard to manage. He refused nourishment and grew very weak, and on September 4, I did not dare to leave them together any longer, and although it was only the sixth day after the operation, I cut off the abdominal flap. It looked healthy, and bled a little from the cut edge, but in a few days began to get gangrenous and finally melted away.

Although the results in both Dr. Lund's case and my own were not satisfactory, still, as will be observed, the conditions in each case were very unfavorable to the production of a satisfactory result. Under proper conditions, I feel sure it will be found entirely possible to transfer in this manner from one individual to another, flaps of desired size and thickness.

BIBLIOGRAPHY.

Hamilton: N. Y. Jour. of Med., Sept., 1854, p. 160
Shrady, G. F.: Rep. by Sir W. McCormick, Birmingham Med. Review,
    vol. xxiv, p. 241, 1888.
Halsted, W. S.: Johns Hopkins Hospital Bulletin, vol. vii. p. 25, 1896.
Steinthal: Beitrage f. klin. Chir., vol. xxix. p. 485, 1901.
Lund, F. B.: Personal communication, April 8, 1902

MASSIVE KELOID OF FACE AND HANDS.*

BY CHARLES A. PORTER, M.D.,

OF BOSTON, MASS.

Surgeon to the Massachusetts General Hospital.

This remarkable case of keloid of the face and hands is reported chiefly to put the photographs upon record, and to show the present result after numerous plastic operations, skin grafts, and spontaneous healing. Although the X-rays were conscientiously tried over several periods there was no benefit. This patient entered the Massachusetts General Hospital, on March 10, 1905, in the service of Dr. A. T. Cabot, whose assistant I was at that time. Dr. Cabot performed the first operation on March 20, 1905; since then Dr. F. G. Balch has operated five times and I myself six times.

History.—Stephen Calabro; Italian; aged 19. Ten months ago patient's face and hands were severely burnt in an explosion in a fireworks factory. He was treated for three months at the Quincy Hospital. Five months ago the region about one of his eyes was skin-grafted at the Carney Hospital, since which time the scars have been steadily growing. *Examination*: Patient's face presents massive keloid extending from the hair-line on the forehead over the whole face, including both ears. A small portion of the right cheek is visible, the eyes appearing as slits in the midst of the exuberant overgrowth.. Slight impairment in hearing; vision in left eye interfered with; mouth can only be opened half an inch. There is excessive keloidal growth on the backs of both hands and lower third of the forearms, the fingers being hyperextended, twisted, and distorted. In numerous places the keloidal tissue is eroded, with some foul discharge from the sulci between adjacent lobules.

Operation, March 20, 1905, by Dr. A. T. Cabot; rectal anæsthesia. Incision over the symphysis of the lower jaw, down to the subcutaneous tissue, with removal of keloid over right side

of chin and part of cheek. Several necrotic areas were found deep in the tissues, in the transitional zone between keloidal and normal subcutaneous fat. On the left, the keloidal mass overhanging the lower jaw was excised, opening an abscess cavity which contained several drachms of pus. Dry dressing; daily X-ray treatment until moderate degree of dermatitis was induced. By April 4 the epidermis was growing very slowly, but there was no return of keloid; distinct improvement in the mobility of the lower lip was evident. On April 18, a typical erysipelas developed which lasted about ten days.

Operation May 31, 1905, by Dr. Porter. The thick plaques of keloid were dissected off in masses from cheeks, forehead, nose, left ear, and lips; in many places down to the subcutaneous tissue. Hemorrhage was very free. This operation required a dozen to fifteen knives, as the tissues were so hard. There was profuse discharge of pus for many days, but at the end of a fortnight the epidermis began to spread in rapidly, and the patient was discharged on June 14 much relieved.

Re-entry December 20, 1905. The keloidal masses have returned but not to their former extent. The left eye is obscured and the eyelids are deformed by scar tissue. A keloid the size of a silver dollar has formed upon each shoulder and another one above the sternoclavicular notch.

Operation December 29, 1905, by Dr. Porter. The recurrent keloid on the right side of the face was shaved off. Wedge-shaped piece cut out from right eyebrow and the edges brought together. A similar wedge from beneath the lower lid was excised and sutured. The keloid at inner canthus of the eye was removed and skin-grafted from the leg. Other grafts were applied over the raw tissues about lower jaw. The grafts took well and by January 17, 1906, only a small area over the lower jaw on the left was uncovered by epidermis. On January 23, more pin-point grafts applied to granulating areas on face. February 1, 1906, another attack of erysipelas of both face and hands.

Re-entry March 6, 1906. Face considerably improved; left eye open and useful, though there is slight cicatricial ptosis and ectropion.

Operation March 14, 1906, by Dr. Balch. Bilateral operation for ectropion; excision of scars with Thiersch grafts from thigh.

By March 28 both grafts, which had taken, showed a tendency to shrink with slight recurrence of ectropion. Keloid forming on area from which graft was taken from thigh.

Operation April 2, 1906, by Dr. Balch. An attempt was made to separate the fingers by excision of the dense cartilaginous-like tissue. Plastic operations were done; the thumb partially freed from scar; but it was impossible to secure proper skin flaps for the denuded area. Hand was dressed with rubber tissue and dry dressing. On April 4· raw surfaces grafted under cocaine, but grafts failed to grow.

Operation April 9, by Dr. Balch. A large crescentic area of scar was removed from beneath the left lower eyelid; a Wolff graft was removed from the right side of chest and fitted to the denuded area. Graft took well under the left eye. In the meantime, there was considerable recurrence of the keloid over the face.

On May 4, under ether, Dr. Porter excised two crescents of the keloidal tissue which overhung both eyes. The wound was then sutured, raising both eyebrows. The recurrent keloids underneath the eyes were completely dissected out with a large keloid which covered the whole right cheek. The growth over the nose was removed down to the subcutaneous fat. Two brothers and a friend were then circumcised and the prepuces used for Wolff grafts, the grafts having been previously punched to allow for drainage, and then sutured in position over all denuded areas. These heterogeneous grafts grew well at first and by the end of the fourth day showed definite evidence of re-established circulation, but on the ninth day all turned black and in a few days separated. On May 28, Dr. Balch rubbed the granulations with gauze and then applied three Thiersch grafts, which, however, failed to take. During the summer the X-rays were used again. The keloidal tissue beneath the lower lids contracted steadily but showed little tendency to increase outward.

In March, 1907, Dr. Balch did plastic operations on two or three of the fingers, separating the webs and loosening up the index finger, and again in April, attempted to gain flexion of the thumb by freeing the extensor and flexor tendons and removing the head of the proximal phalanx of the thumb. Primary union, but no marked improvement in motion.

On June 24, Dr. Porter dissected out the cartilage of the

FIG. 1.

FIG. 2.
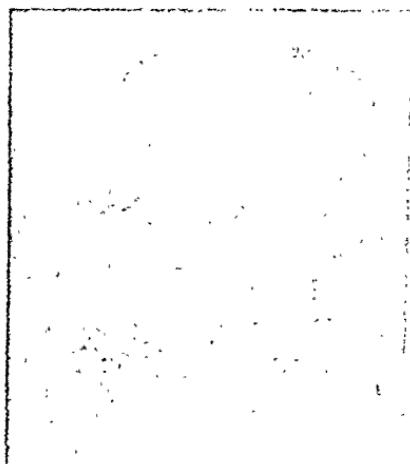
Condition on entrance to hospital, March 12, 1906.

FIG. 3.

Condition of hands, March 12, 1906

FIG. 4.   FIG. 5

Condition, May 27, 1905.

FIG. 6.   FIG. 7.

Condition, November 4, 1905.

FIG. 8.

FIG. 9.
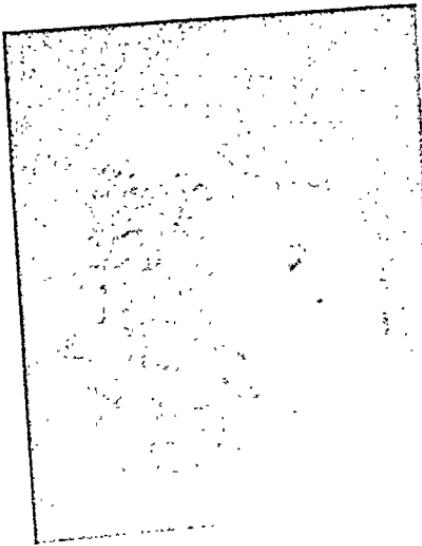
Condition, January 6, 1906.

FIG. 10.

May 6, 1906, showing result of grafting
and myopial graft on May 4, 1906

FIG. 11.   FIG. 12.

Present condition, June 1, 1909.

right ear, which was involved in the keloidal growth; Thiersch grafts were applied. The left ear was also freed, as was the lower lip. Skin grafts were applied to all raw surfaces, and the mass above the suprasternal notch was excised and the edges sutured.

Operation July 12, 1907, by Dr. Porter. The cicatricial tissue which was causing hyperextension at the right wrist was removed and the area skin-grafted. The thumb was freed and a graft applied between it and the index finger. The webs which formed between the middle and adjacent fingers were pierced obliquely from behind forwards and downwards, and through the opening a piece of rubber dam was drawn. The right ear was freed at its top and the raw surfaces were skin-grafted. By August 15 the skin had grown about the rubber setons at the base of the fingers, and the web was cut under cocaine.

On August 24, 1908, Dr. Porter removed a thick mass of scar tissue holding the ear to the scalp. Another operation was performed for recurrent ectropion of the left eye, a crescentic excision being made and a Wolff graft from the thigh applied; graft took well.

On September 14, 1908, re-entered; operation by Dr. Porter. Further freeing of the right ear and removal of keloidal masses; areas skin-grafted and the patient discharged September 30, 1908.

Résumé.—After many operations, the photographs show the present result. There has been a gradual but distinct abatement of the tendency to form keloidal tissue. The forehead is covered by shiny, movable skin, resulting partly from natural healing and partly from skin grafts. There is some keloid about the deformed ears, but both show evidence of their presence. The nose and cheeks are fairly normal, but there is still some ectropion in spite of the numerous operations. The hands have been improved so far as ability to grasp objects with the thumb is concerned, but dorsal hyperextension of the fingers still persists, as shown in the photographs. X-rays seem to have been of no value.

TRANSACTIONS

OF THE

AMERICAN SURGICAL ASSOCIATION.

Annual Meeting held at Philadelphia, Pa., June 3, 4, 5, 19ᶜ
The President, CHARLES B. G. DE NANCRÈDE, in the Chair.

I. ADDRESS OF THE PRESIDENT: THE END RESULTS AᵣＩᴴ
TOTAL EXCISION OF THE SCAPULA FOR SARCOMA.

DR. CHARLES B. G. DE NANCRÈDE, of Ann Arbor, Mich., gaᵥ
the Annual Presidential Address; his topic was as named at ᵥ
For the address in full see page 1.

II. CHRONIC INTESTINAL STASIS.

MR. W. ARBUTHNOT LANE, of London, Eng., read a paper
Chronic Intestinal Stasis, for which see page 190.

DR. J. C. BLOODGOOD, of Baltimore, called attention to tʰ
X-ray examination as a method of diagnosis which he tᶦ ᶦⁿᵏ
will be more frequently used in the future. He presented
rough sketch of the condition found in a recent patient, a fᵣᵛ
report of whose history will be published later; he also referr⁻
to a former case which is now well for two years without havᵢ,
had a resection.

DR. T. W. HUNTINGTON, of San Francisco, considered ᶦ⁺,
principal significance of the subject under discussion was tʰ
idea of the prevention of the conditions. He was of the ᵤᵢ ⁿᶦᵢ
that these cases of enteroptosis, bearing especially upon the ⁻ ᵇ
bowel, could be avoided by careful attention in early life to ᶦᶦ.
emptying of the bowel, and that this accumulation is due usualₗ
to a definite cause giving rise to sufficient irritation to interruᵢ
the peristaltic wave, as, for instance, in cases of occult appendᶦᶦ ᶜ
DR. ARTHUR DEAN BEVAN, of Chicago, was of the opiniᶦᶦ
that Mr. Lane's suggestions were rather radical. He said ᶦ.

should insist upon a condition which should be described absolutely as that of intestinal obstruction, before he would feel warranted in undertaking such an operation as an anastomosis or the removal of a part or the whole of the colon. He considered the subject of chronic constipation one which should be dealt with jointly by the internist and the surgeon.

DR. J. F. BINNIE, of Kansas City, said that in a number of these cases he had done a cecostomy with very fair temporary results, although he has been unable to learn the ultimate results.

DR. JOHN B. ROBERTS, of Philadelphia, stated that he understood Mr. Lane to advocate surgical operations in these cases only when all other means had failed, and he then believed this surgical interference should be prolonged and radical.

DR. MAURICE H. RICHARDSON, of Boston, called attention to the fact that he had reported two or three cases of chronic intestinal obstruction. He believes the surgery of the large intestine should not begin by at once operating for obstinate and chronic constipation, although early exploration in cases of chronic constipation will relieve many pathological conditions which can be treated as easily as the simple incision of a band. It is his firm opinion that an exploration should be made in all cases of obstinate intestinal obstruction, whether called constipation or obstruction, and that such serious and dangerous operations as the complete resection of the large intestine should be avoided.

DR. WM. B. COLEY, of New York, said that while believing in conservatism he did think that too often these cases were allowed to go too far without surgical interference. He called attention to the fact that nine such cases operated upon for volvulus of the sigmoid at the Massachusetts General Hospital had terminated fatally. He reported a case of his own operated upon on the ninth day for acute obstruction. The abdomen was opened under cocaine and the giant sigmoid fastened to the abdominal wall, and a large amount of liquid fæces evacuated through a tube in the bowel. In a week the patient began to have natural passages by the rectum; at the end of two weeks the wound had healed. The symptoms then reappeared, and in a short time he had increasing distention. Dr. Coley did not think it wise to resect the sigmoid but introduced a small silver tube into an opening for the escape of gas, and this the patient has been wearing for a year.

MR. LANE, concluding the discussion, said that in the discussion no mention had been made of what he considered the most important points in the paper, the toxic results of auto-intoxication. He believes it is growing to be more the general opinion that the intestinal tract is no longer to be only treated by drugs from above or enemas from below.

III. THE RELATION OF MESENTERIC DISTORTION TO INTESTINAL OBSTRUCTION.

A paper upon the above subject, by DR. JOSEPH D. BRYANT, of New York, in the absence of the author, was read by title. It is published in full beginning at page 229.

IV. THE FECAL ORIGIN OF SOME FORMS OF POSTOPERATIVE TETANUS AND ITS PROPHYLAXIS BY PROPER DIETETIC OR CULINARY MEASURES.

DR. RUDOLPH MATAS, of New Orleans, read a paper with the above title, which he summarized as follows:

1. Notwithstanding the vast increase in our knowledge of the etiology, pathology and prophylaxis of tetanus since the discovery of the drumstick bacillus of Nicolaier, twenty-six years ago, a certain—not full determined— number of postoperative deaths from this infection occurs in seemingly clean surgical cases, a circumstance which has not been satisfactorily accounted for.

2. While it has been fully and irrefutably demonstrated that the regional liability of the exposed parts of the body to tetanus (i.e., feet, hands, legs, forearms, arms, face, neck, etc.) is directly proportional to the degree of surface contact with tetanus-bearing (tetaniferous) matter (earth, manure, dust), the origin and regional distribution of accidental and postoperative tetanus in the concealed parts of the body (protected from surface exposure) has not been sufficiently investigated or recognized. Surely not sufficiently insisted upon in accounting for postoperative deaths in which the rules of surgical asepsis have been apparently well observed.

3. Abundant experience has shown that while the risk of tetanus infection can be absolutely eliminated in all operations upon sterile tissues in which a rigorous postoperative asepsis can be maintained until healing has occurred, this liability cannot be removed in those regions in which postoperative asepsis cannot be secured.

4. In order of importance next to the feet and hands and other exposed parts of the extremities, the injuries and surgical operations in those regions of the body which are most exposed to fecal contamination, are the most liable to tetanic infection. In this category we will place the anorectal region, perineum, female genito-urinary tract, male genitals (especially scrotum), lower pelvic region (including buttocks, sacrococcygeal region), groins, thigh, knee, upper leg, on their posterior surfaces especially; after operations on the intestines, artificial anus, etc., in all of which postoperative fecal contact is either constant or unavoidable on account of proximity to the intestine. In considering this topographical distribution we are excluding the direct but unconscious transmission of fecal matter to distant parts of the body by the soiled fingers of the patient himself or of his attendants.

5. The careful attention to the sterilization of instruments and the disinfection of the hands compelled by the rules of modern surgical, obstetric and veterinary practice, have enormously reduced the liability to tetanic infection, even when those parts of the body are involved which are most exposed to fecal contact, by eliminating the direct inoculation of wounded surfaces with contaminated instruments and hands. However, the occasional postoperative deaths which occur from time to time in the practice of competent and clean surgeons clearly point to another source of danger which is not dependent upon defects of technic or contaminated material (e.g., imperfectly sterilized catgut), but to other sources of infection outside of and apart from the operative act itself, which have not been adequately appreciated.

6. This hitherto unrecognized or disregarded factor in the causation of postoperative tetanus, at least in regions liable to fecal contact, is the direct contamination of the alimentary canal and its contents with living tetanus bacilli and their spores, swallowed in raw, uncooked vegetables, berries and other fruits which are cultivated in fertilized or manured (i.e., tetanized) soil (Robinowitsch, Kolle and Hetsch, Miquel and Cambrier, Kolle and Wassermann, Thalmann, Hecker, et al.).

7. It may be a mere coincidence, but it is a fact, that in all the cases of postoperative tetanus occurring after operations in regions liable to fecal contact, which have been investigated by the author (two in his own practice), the patients had eaten

copiously of uncooked vegetables immediately before the operation. The vegetable menu in these cases correspond with the laboratory findings in regard to the vegetables found most frequently contaminated with tetanus germs and spores, viz., celery, lettuce, chicory, watercress, cabbage (cold slaw), radishes, turnips, carrots, tomatoes and other green vegetables, strawberries, blackberries and other berries and fruits which are grown in the soil or brought in contact with it and which are largely consumed raw in an unavoidably contaminated state.

8. The tetanus bacillus and its spores are known to survive the passage through the intestinal canal of the domesticated animals, especially the herbivorous horse and cow, and the dung of these animals is a perpetual culture medium for the tetanic bacillus, swallowed constantly with the grass of the pasture and the fodder of the stable; not only are the bacilli ejected alive, but their virulence and activity are probably intensified by their temporary residence in the favorable conditions of the lower intestinal tract (Sormani). This survival of the tetanus germ in a virulent state is fully demonstrated by the experiments of Sormani, Sanchez Toledo, Veillon and Hoffmann, et al., who demonstrated that the diluted excrement of the horse and cow, injected subcutaneously and otherwise, will kill rabbits in from five to six days with all the symptoms of this disease. These and other authors have fully demonstrated that the spores of the drumstick bacillus resist the action of the digestive juices; it has also been demonstrated that the tetanus-laden fæces of the healthy horse and cow are capable of producing fatal tetanus when brought in contact with wounded surfaces in these animals.

9. In view also of the fact that 5 per cent. of all normal men harbor the tetanus bacillus or its spores in an active state in the intestinal canal, and that the percentage of contaminated individuals is increased to 20 per cent. in hostlers, stablemen, dairymen, drivers, etc. (Pizzini), the possibility of tetanus from fecal contact must always be kept in mind, especially when operating upon the anorectal region, perineum and genito-urinary organs of both sexes, in unprepared subjects.

10. The author fully recognizes that the normal defences of the organism against intestinal infection are, in healthy individuals, usually sufficient to protect it, even if the living tetanus bacillus has been freely introduced into the alimentary canal with

the ingested food. It is only through the salutary and preserva-tive influence of the protective mechanism, which largely neu-tralizes the most virulent infection in the alimentary canal, that we can account for the great numbers who escape when opera-tions are performed in the recognized tetanogenic regions. It is evident, however, that even if tetanus infection is a compara-tively rare postoperative sequence, it is well worth the observ-ance of the simple precautions required to avoid this deadly acci-dent. Precautionary measures would be more than justified if only one in ten thousand operative cases could be saved from the almost certain death which follows when this form of inocu-lation occurs after operation.

11. In accordance with the preceding statements, and his own convictions, the author has taught and insisted in his own prac-tice, since his last and second postoperative death from tetanus (perineoplasty and hemorrhoids) occurred five years ago, that no patient should be brought to operation without antitetanic preparation, whenever an operation is to be performed upon parts in which fecal contamination is unavoidable (hemorrhoids, fissure, fistula, stricture, etc.).

12. This antitetanic preparation is very simple, and consists in: (a) purgation, three days before the operation; (b) the suppression of all raw, uncooked food, especially green vegetables, berries and other fruit (for the same period of time before the operation). In emergencies when dietetic preparation is impos-sible, 10 c.c. of tetanus antitoxin are injected subcutaneously at the time of the operation, while the patient is still under the anæsthetic.

DR. JOHN E. OWENS, of Chicago, mentioned a case of a woman past middle age suffering from tetanus; she had received no wound, but two or three days before the attack she had had a tooth pulled. She was fond of working in the garden and was also fond of fresh celery, of which she had been eating freely, and it was therefore thought that her tetanus might have been caused by indulgence in this vegetable.

DR. ROBERT W. JOHNSON, of Baltimore, referred to a paper on this subject of tetanus which he had read at a previous meet-ing of the association, and said he did not recall reporting a single case occurring from fecal origin, although there were a number of postoperative cases following herniotomies, appen-

dectomies, hysterectomies, etc. These cases were assumed to have been produced by infection through the catgut used. He said that he had seen a case of tetanus resulting from rectal operation where instead of trismus as an early manifestation there were rectal spasms. He considers it surprising, in view of the facts mentioned by Dr. Matas, that he has not more frequently met with cases of tetanus after rectal operations.

DR. W. H. HUTCHINGS, of Detroit, said he had recently had an opportunity of treating three cases of postoperative tetanus, one of which followed an abortion. In one of the cases, that of a crushing injury to the hand in which a skin-grafting operation was done, the patient did not develop tetanus for a month after the injury; he considers this an evidence that tetanus spores can remain latent for a long time.

DR. JOSEPH RANSOHOFF, of Cincinnati, said that in his experience he had never seen a case of tetanus following a rectal operation. He mentioned a case in the practice of another surgeon, which he had seen, where instead of a trismus there was an open mouth, which he considered a rather rare condition.

DR. MAURICE H. RICHARDSON, of Boston, said he had never seen a case of postoperative tetanus, and considered it a very rare condition. He therefore thought it would be rather a radical procedure to follow Dr. Matas' suggestion of using antitetanic serum in all rectal cases.

DR. A. G. GERSTER, of New York, said that in thirty-two years of surgery he had encountered not one case of postoperative tetanus.

DR. BEVERLY MACMONAGLE, of San Francisco, said that in an experience of over thirty years he had seen but one case of postoperative tetanus, and that was a case of trachelorrhaphy in which catgut was used. In consideration of Dr. Matas' statements he thought his own experience unusual, as he frequently operated among the poor class of Italians, under most adverse conditions in their own homes, and yet had never had a tetanus resulting after operation.

DR. EDMOND SOUCHON, of New Orleans, referred to a case upon which he operated for hemorrhoids and the patient died on the eighth day from tetanus; also a case in which the cæcum was resected which was followed by death from tetanus.

DR. WILLY MEYER, of New York, mentioned a case of interval operation for appendicitis, after which the patient developed

tetanus but made a good recovery. The catgut used was supposed to be the cause of the tetanus, but Dr. Meyer is of the opinion that it might have been caused by what he calls the pseudotetanus bacillus, which is sometimes found in the appendix, according to the literature on the subject.

DR. F. H. GERRISH, of Portland, referred to two cases of postoperative tetanus, one resulting after ligation of hemorrhoids, and the other after an operation upon a necrosed tibia. It is his opinion that cases of tetanus come in waves, some years it being quite prevalent, and then there being few instances in other years. He will be careful in his future intestinal operations to see that his patients eat no raw food or vegetables for some days previously.

DR. J. COLLINS WARREN, of Boston, considered tetanus to a certain extent to be a tropical disease, and that latitude exerts some influence upon the growth of the bacillus; also that occasionally it is epidemic.

DR. STANLEY STILLMAN, of San Francisco, had had no personal experience with tetanus, but remembered being taught by Dr. Lane, a former member of the association, the great danger of tetanus following ligature operations for hemorrhoids, and as a result of this teaching he had always been most careful in the preparation of his patients for operation.

DR. A. VANDER VEER, of Albany, could recall no case of tetanus following operations upon the rectum in his experience. He referred to an editorial regarding the disposal of sewage in Los Angeles and Pasadena, which criticized very severely the method of using the sewage for irrigation of the poor farms and other lands where they raised vegetables which grew above the ground and which are eaten in an uncooked state. He is not at all opposed to the prophylactic dose of antitetanic serum, which he uses frequently.

DR. GEORGE E. BREWER, of New York, saw no objection to the use of the prophylactic dose of antitetanic serum, stating that it was used in all cases of injured hands and feet in the accident department of the hospital with which he was connected.

DR. DUDLEY P. ALLEN, of Cleveland, said that some summers ago at the Cleveland Hospital they had a number of cases of tetanus from the use of the toy pistol; every one of these cases which were opened and packed recovered, but those which were not so treated died early from tetanus.

DR. C. B. G. DE NANCRÈDE, of Ann Arbor, mentioned the fact that there were certain portions of the country where tetanus was practically never encountered, while in other portions it was very prevalent. There is a great deal of it in the country round about Ann Arbor, and there is a standing order to Dr. de Nancrède's internes to give a prophylactic dose of antitetanic serum in all cases where the wound is of a kind likely to lead to tetanus. For eleven years Dr. de Nancrède has been in the habit of warning his students of the dangers of unripe fruit as possible sources of tetanus, and is rather surprised that so few believe in this origin of the disease.

DR. ROBERT G. LE CONTE, of Philadelphia, reported a case occurring fifteen years ago in the practice of one of his friends. The patient had undergone an operation for the repair of the cervix and perineum, and on the seventh or eighth day developed tetanus, from which she died. He mentioned the fact that the Pennsylvania Hospital of Philadelphia had for many years following the Fourth of July many cases of tetanus to treat, but that since using the immunizing dose of the antitoxin there had not been a single case.

DR. MATAS, concluding the discussion, said that the preparation of the patient to which he referred in his paper was not the preparation preliminary to operation, which most surgeons were very particular about, but a preparation extending back for some three or four days, in order that the bowels might be thoroughly cleaned out with no possibility of a fecal contamination following operation. He believed that where such preparation was not possible it was a wise precaution to use the immunizing dose of the antitoxin. He stated that warm latitudes seemed to predispose to the disease, especially in times of peace, while in times of war it seemed to make but little difference. He suggested that another reason why tetanus was not so prevalent in northern latitudes was that the soil there was not so laden with the tetanus bacillus.

V. THE HISTOPATHOLOGY OF GOITRE.

DR. FRANCIS W. SHEPHERD, of Montreal, read a paper in which he gave the results of a microscopical study of over fifty cases of thyroidectomy, for which see page 84.

DR. WILLIAM S. HALSTED, of Baltimore, stated that at one time he had performed some experiments on dogs for two years

at a time, and found that when once the hypertrophy of the glands was produced by the ordinary cause it did not change for at least two years.

Dr. CHARLES H. MAYO, of Rochester, said that his own cases bore out in the main the report given by Dr. Shepherd, and that the more thyroids he examined the more simply he reduced the pathology of the condition. He looks upon the term colloid, as found in a thyroid, as a complement to the real secretion, and not the secretion itself.

Dr. RUDOLPH MATAS, of New Orleans, spoke regarding the thermic development in operations upon the thyroid glands. He cited the case of a recent patient whose temperature an hour after partial resection of the gland went up to 105.°. He suggested the use in these cases of high temperature, of Blake's tubes in the rectum, by which ice-water is administered in large quantities. This has always been most successful in his hands.

Dr. FRANCIS J. SHEPHERD added that he found a high temperature after operation chiefly in exophthalmic cases, but in simple goitre it was caused by serum, and when this was removed the temperature would fall.

VI. THE PARATHYROID QUESTION.

Dr. CHARLES H. MAYO, of Rochester, Minn., read a paper with the above title, for which see page 79.

Dr. JOHN H. GIBBON, of Philadelphia, referred to a case of tetany occurring in a patient from whom he had removed the entire right lobe of the thyroid. The condition developed on the fourth day after operation, became very bad, and the patient's mental condition grew distressing; calcium was conscientiously tried, as was also the feeding of the patient with the parathyroid of beeves, but with no effect. A number of months later the patient was reported as much worse, and then nearly a year later she was said to have practically recovered. Dr. Gibbon did not know the ultimate outcome of the case.

Dr. WILLIAM S. HALSTED, of Baltimore, said that he felt there was practically no danger of tetany following a case operated upon by Dr. Mayo's method. He considers one reason why tetany occurs so seldom is because so infrequently both lobes of the thyroid gland are removed. He cited one case of tetany which was treated most successfully by lactate of calcium.

He also mentioned some experiments upon the parathyroids of dogs, where it was found possible to keep the dogs alive for some time on one transplanted parathyroid.

DR. FRANCIS J. SHEPHERD, of Montreal, said he had never seen a case of tetany following an operation upon the thyroid gland. In all cases of partial excision of the thyroid glands he carefully examines for the parathyroids, and frequently finds them embedded in the inside of the gland.

DR. MAURICE H. RICHARDSON, of Boston, said that the only cases of thyroids which he had to deal with were those sent to him from practitioners who were afraid to deal with them on account of their size, and that he had never seen a case of tetany nor a parathyroid body.

DR. L. L. MCARTHUR, of Chicago, reported a fatal tetany following a case of goitre removal with resection of both lobes, in which the parathyroid bodies, which were demonstrable on the right side, were removed. The patient presented symptoms of tetany on the fifth day; thyroid extract was administered, and he went home with his wound healed and the tetanic symptoms in subsidence at the end of two weeks. Ten days later, or twenty-four days after the operation, having been in the meanwhile around the house, he was suddenly again seized with the tetanic convulsions, and died in ten hours. Dr. McArthur ascribed this to a pure tetany independent of any infective process.

DR. N. B. CARSON, of St. Louis, reported a case of removal of the thyroid gland in which some time later the patient developed an immense keloid along the line of the scar.

DR. CHARLES H. MAYO thought that the resemblance to the thyroid gland found by Dr. Halsted in removing the parathyroid gland which had been transplanted in one of the dogs upon which he was experimenting, would show the association of function of these various glands. He said that, as Dr. Shepherd had stated, the parathyroid body was sometimes found in the capsule of the gland, although this was not its usual position.

VII. EXCISION OF THE LARYNX FOR CARCINOMA.

DR. JAMES BELL, of Montreal, read a paper with the above title, for which see page 92.

DR. W. W. KEEN, of Philadelphia, referred to a paper read by him when he was President of the Association, the title of

which was "Total Laryngectomy," no one feature of his method being new, but simply a novel combination. The two features he insisted upon were the exaggerated Trendelenburg position and the avoidance of any preliminary tracheotomy, and the keeping of the patient for two or three days subsequent to the operation in the Trendelenburg position. He stated that his first patient is now well at the end of eleven years, and can be heard at a distance of thirty feet without any artificial larynx.

DR. GEORGE E. BREWER, of New York, stated that the mortality in these cases, according to his experience, agreed with those reported by Dr. Bell, but that he followed a different form of technic. His first case was done nearly eleven years ago, after the method of Dr. Keen. Following that one success he had many disastrous results, in all of which cases he did no preliminary tracheotomy. He now does a preliminary tracheotomy ten days prior to operation, exposes a large amount of trachea, packs with iodoform on either side with a view to creating dense adhesions which act as a bar to the descent of infection. He removes the larynx from below upward, closes the pharynx and does not lift up the trachea. Since following this plan he has had no operative mortality, and the cases have been more comfortable than ever before. With regard to feeding, he introduces a nasal tube in the lower portion of the œsophagus and begins feeding from the start with concentrated foods, just after the patient comes out of ether, and water in six hours.

DR. N. B. CARSON, of St. Louis, suggested that rectal anæsthesia employed in these cases would add much to the comfort and chances of recovery of the patient.

DR. ROSWELL PARK, of Buffalo, reported a death following laryngectomy. He used subnitrate of bismuth instead of iodoform; the patient did well for two or three days and then died. An autopsy was performed and every particle of mucous surface was found covered with bismuth paste; the bismuth had become mixed with saliva, then with the mucus, and had spread itself over the patient's breathing surface so as to completely choke off all possibility of æration.

DR. GEORGE W. CRILE, of Cleveland, reported 20 total laryngectomies, the first 8 performed without fixing the trachea, the last 12 along the lines described by Dr. Brewer. There were 2 immediate fatalities in the first 8 and none in the last 12. The

results were quite satisfactory. The first case is living after 16 years; one patient died in 5 years from pneumonia; one living after 4 years; one after 3 years, and the remainder are all recent operations.

Dr. BELL said that he thought it unnecessary to fear infection extending down the neck if the patient were kept in the Trendelenburg position and the wound not too completely closed. He considered the feeding question most important, but does not look with favor upon the performance of a gastrostomy, as suggested by some operators.

VIII. FURTHER OBSERVATION ON TRANSFUSION; WITH A NOTE ON HÆMOLYSIS.

Dr. GEORGE W. CRILE based this further report on transfusion on recent experience. The vein makes a better cuff than the artery, and he emphasizes the importance of dilating the end of the artery before drawing it over the cannula.

It has been found, contrary to common belief, that kinship is of no special advantage, any normal blood doing as well. The condition of the heart is the most important consideration in transfusion. When there is a heart lesion with compensatory hypertrophy the muscle is working near its maximum and its normal factor of safety may be lost.

In deep anæmia there is impairment of the heart muscle. If in such a case blood be transfused rapidly and under full pressure, there is striking improvement, but great caution is necessary, for dilation may follow with stagnation of the circulation. This condition is met by carefully adjusting the rate of flow and by noting the first sign of dilation, when the flow is checked or stopped. Cardiac stimulants and observation of change in heart dulness are the effective prophylactic measures. The most effective active measure consists in the rhythmic compression of the chest, which forces the blood from the thorax, improving the circulation.

As to clinical results there is no modification of previous conclusions, viz.: In pernicious anæmia, toxæmia, certain drug poisoning, leukæmia, Hodgkin's disease, carcinoma and uræmia, no benefit has been observed. A case of hyperthyroidism was apparently benefited. A case of pellagra, transfused from an immune donor had a rapid convalescence. If done early, trans-

fusion is a specific for an acute hemorrhage. In suitable cases it has been of great value in the prevention and relief of shock. Certain amount of encouragement has followed transfusion in tuberculosis.

In operative surgery, cases where hemorrhage and anæmia exist, or where the patient is reduced by disease or starvation so that an operation is out of the question, transfusion will make it possible. The technic of transfusion is exacting, and may be difficult, and is rarely necessary in the routine surgical work.

In regard to hemorrhage, it is, first, but one form of action between the blood of one individual and that of another; secondly, that if there is hæmolysis *in vitro* it by no means necessarily follows that there will be hæmolysis *in vivo*. This is especially so in tubercular cases where hemorrhage has occurred *in vitro*, but transfusion was performed with no unfavorable results.

Hæmolysis is a valuable aid in the diagnosis of acute tuberculosis, the reaction occurring more frequently than in cancer. In the latter, hæmolysis usually occurs in the earlier stages, rarely in the later.

Dr. George E. Brewer, of New York, said that one remark of Dr. Crile's would be appreciated, and that was that even direct transfusion is attended with a good many mechanical difficulties. He thought one found transfusion much more complicated when tried upon a human being than when done on animals. He has devised some glass tubes which if placed in boiling paraffin before introduction, the blood will not clot on them, thus assuring a steady stream from the donor to the donee.

Dr. William S. Halsted, of Baltimore, referred to experiments made some thirty years ago, in centripetal transfusing of the animals, and wished to know Dr. Crile's opinion of this method of transfusion where the patient had a weak heart. He also stated that somewhat the same method as suggested by Dr. Brewer had been tried at Johns Hopkins Hospital with silver tubes. He spoke of another method of transfusion, which, while not considering it as good as Dr. Crile's, he thought still had its uses. Two tubes are used, one for the vessel of the donor and one for the vessel of the donee, and these can be quickly joined together.

Dr. John H. Gibbon, of Philadelphia, said he had used Brewer's tubes with a great deal of satisfaction, while he had not found Crile's so easy of manipulation.

DR. DAVID BARROW, of Lexington, wanted to know in cases where shock was dependent simply upon the question of centripetal embarrassment, whether Dr. Crile had ever been able to demonstrate the value of the transfusion of blood.

DR. CRILE said he wished to recommend Brewer's method, which seemed simpler than his own. In reply to Dr. Halsted he stated that in his opinion centripetal transfusion was of the utmost importance in cases of weak heart. With regard to Dr. Barrow's query he stated that the transfusion of blood overcomes to a great degree the circulatory depression of shock.

IX. TUBERCULOSIS OF THE PERICARDIUM CURED BY INCISION AND DRAINAGE.

DR. CHARLES L. GIBSON, of New York, stated that operation, if any, for the relief of tuberculous pericarditis must be rare, but the fact that a cure was obtained in the case he presents makes it worthy of record.

The case was as follows: Male, negro, aged 26, whose past history was without features except for an ischiorectal abscess three months ago. Family history for tuberculosis is negative. For past two months has had a heavy cough with slight expectoration; for past two weeks dyspnœa has been so bad that he could not lie down, sleeping in a chair; swelling of the feet noted six days ago. Physical examination showed a man of fairly large frame, fairly well nourished; breathing with some difficulty and with an expiration grunt. Heart percusses 1½ inches to *right* of sternum and 6 inches to left. Sounds of poor quality and hard to hear. Considerable bronchitis. Five days after admission pericardium was aspirated in fifth space and 18 ounces of opaque, yellowish fluid were obtained. Finally it was decided, as there was not marked improvement in the patient's condition, that operative interference was indicated. Attempts were made at local anæsthesia, but these attempts, because of the lack of self control of the patient, were found in vain. Chloroform was then given to the point of unconsciousness, followed by ether. An incision was made in the long axis of the left fifth cartilage, a bit of the rib and also the fourth cartilage removed. The greatly distended pericardium was seized between two Kocher clamps and a two-finger incision gave issue to a great volume of pus, probably a quart. The pulse was

perceptibly weakened by the flow, and it was therefore blocked. The sac must have contained three quarts. The pericardial edges were sutured to the soft parts and a rubber drainage tube passed into each lateral cul-de-sac. The subsequent drainage was profuse. Since operation the patient's condition has been poor, and he is now again in the hospital as an inmate of the tubercular ward, the presence of a tubercular process in the lung being now manifest; tubercle bacilli were not found till recently, notwithstanding almost daily examination of the sputum. The pericardial healing has persisted, evidences of an adhesive process being manifest. That such a severe process can result in a cure in the face of an advancing tubercular diathesis is considered most remarkable, and certainly makes surgical measures in such cases seem justifiable.

X. VISCERAL PLEURECTOMY.

Dr. Alexander Hugh Ferguson, of Chicago, after defining visceral pleurectomy (decortication of the lung, or Fowler's operation) to be removed by operation of the thickened visceral pleura in cases of chronic empyema, referred briefly to the work of Fowler (1893), Delormè (1894), Reclus (1894), Gallet (1895), and his own in 1896, as the earliest work done of this kind. He explained the advantages of a partial visceral pleurectomy, clearing out the apex of the lung while the ribs were being removed (Schede), but cautioned against doing too much at one sitting. The indications for the operation were stated somewhat as follows:

1. Suppurating cavity remaining after drainage and various rib resections had been performed.

2. The absence of tubercular foci in the lung that is bound down, or in other parts of the body, lend favor to the procedure being a success; but even these conditions need not deter the surgeon when the patient can withstand the operation. Once the drain on the system caused by the suppuration is stopped, the patient has a better chance to overcome the tuberculous infections wherever they may be.

3. When amyloid disease of the internal organs is beginning to manifest itself, then the operation should no longer be delayed.

4. When it becomes clear that in a certain case the cavity had no further tendency to close, then this operation should be seriously considered.

The pathology, both macroscopic and microscopic, of the visceral pleura removed was very carefully and minutely given. In describing the operation, Dr. Ferguson gave preference to a mid-axillary incision, and clearing away all cicatricial tissue, stumps of ribs, etc., in his way to get at the visceral pleura. The offending covering of the lung is boldly cut through to sound lung tissue and cut away en masse if possible. Should the lung have a tendency to bulge out it should be compressed with moist gauze. After cleaning out the apex of the cavity the operation should not be completed if the patient shows signs of weakening, for the major part is now done, and the rest of the thickened pleura may be exsected afterwards under local or gas anæsthesia.

Dr. Ferguson had operated on six cases, and obtained complete success in every instance. In the preparation of cases of chronic empyema for operation, and in carrying out the after treatment, the doctor gave great praise to 33 per cent. of bismuth subnitrate in white vaseline used as a paste to fill all sinuses and cavities as invented and practiced so extensively by Dr. Emil G. Beck, of Chicago. It has been proven that Beck's paste improves all such cases and cures many of them, thus often rendering it unnecessary to do a major operation like visceral pleurectomy.

Dr. Ferguson presented a skiagraph of a case operated on by this method, which showed but a small strip of lung tissue left, a pneumonectomy having been practically performed, and the patient made an excellent recovery.

XI. OPERATIVE TREATMENT OF TUBERCULOSIS OF THE LUNGS.

Professor Dr. P. L. Friedrich, of Marburg, Germany, read a paper with the above title, for which see page 135.

XII. ŒSOPHAGOGASTROSTOMY AFTER INTRATHORACIC RESECTION OF THE ŒSOPHAGUS.

Dr. Willy Meyer, of New York, read a paper with the above title, for which see page 175.

XIII. RESECTION OF THE RIBS COMBINED WITH EXTERNAL PRESSED IN THE TREATMENT OF TUBERCULOSIS OF THE APEX OF THE LUNG.

Dr. Leonard Freeman, of Denver, Colorado, read a paper with the above title, for which see page 145.

XIV. A CONSIDERATION OF SURGICAL PROCEDURES DESIGNED FOR THE RELIEF OF PULMONARY TUBERCULOSIS.

DR. CHARLES A. POWERS, of Denver, read a paper with the above title, which will be published in a future number of the ANNALS OF SURGERY.

XV. EMPYEMA THORACIS.

DR. ALBERT VANDER VEER, of Albany, New York, read a paper with the above title, for which see page 158.

XVI. THE TREATMENT OF POSTOPERATIVE FISTULÆ AND ABSCESSES FOLLOWING OPERATIONS FOR EMPYEMA.

DR. ALBERT J. OCHSNER, of Chicago, Illinois, read a paper with the above title, for which see page 151.

XVII. THE OPERATIVE TREATMENT OF HEART WOUNDS.

DR. CHARLES H. PECK, of New York, read a paper with the above title, for which see page 100.

The following discussion on thoracic surgery ensued.

DR. JOHN E. OWENS, of Chicago, reported the case of an engineer who was struck in the chest by a piece of molding from the cab of his train in a collision. The piece of molding was 12 feet long. This struck the engineer over the third rib just external to the heart, passed upwards and inwards, coming out at the second rib. He ultimately recovered and returned to work.

DR. A. G. GERSTER, of New York, considered the suggestions of Friedrich very valuable additions to the technic of thoracic surgery. He referred to a recent case of his own, in which the patient, having had a pulmonary tuberculous cavity of the apex suffered a perforation into the pleural cavity. A limited removal of the ribs was done without much effect, and then ten ribs were resected, beginning from the first to the tenth, the approach to the cavity being in the axillary line. The main difficulty was in the resection of the four or five upper ribs. He considers it important to note that in this instance there was no difficulty in removing the first rib. The patient is doing well and an ultimate recovery is looked for.

DR. JOHN B. MURPHY, of Chicago, said that the principles

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underlying all operations on the thoracic cavity were pulmonary rest and drainage of cavities, to be secured in the early stages by intrathoracic compression with air or gas. If the lung is put at rest cicatrization results and then repair. He also alluded to the pathology of empyema.

Dr. George Tully Vaughan, of Washington, spoke especially with reference to surgery of the heart, stating that in the last year he had had another case recover after suture of the heart. Statistics show that gunshot wounds of the heart give a smaller mortality than stab wounds, which seems rather surprising; also that the highest mortality followed wounds of the right ventricle.

Dr. Richard H. Harte, of Philadelphia, referred to cases of suture of the heart, and said he always had had the greatest difficulty in the introduction of sutures in wounds of the auricle especially.

Dr. Joseph Ransohoff, of Cincinnati, with regard to cases of empyema, said he knew of no class more satisfactorily treated than the acute empyemas in young subjects, which usually heal very promptly and do not become chronic unless allowed to do so before operation. The neglected cases are the ones in which difficulty is encountered. He referred to Fowler's method of removing the pleura from the surface of the lung, which he had followed several times with good results. The subject of the differential pressure apparatus was broached, and the suggestion made that where it was impossible to use this apparatus the lung be grasped as soon as the chest wall is opened, brought into the wound and attached to the wound edges with sutures. He considers a suddenly developed pneumothorax an exceedingly serious thing, often causing death.

Dr. Joseph A. Blake, of New York, spoke with regard to the technic of operations upon the thorax, referring to recent experiments made by Drs. Greene and Janeway. In carrying out the work of the positive pressure apparatus the idea was suggested that the old intralaryngeal method had advantages in that an artificial apnœa could be induced, inhibiting the patient's respiratory movements so that the operator is not embarrassed by the excursions of the diaphragm. They have therefore devised a valve which works rhythmically, increasing the pressure 8 to 10 mm. in the chamber; the patient soon stops breathing of his own volition and the respiratory movements of the chest become

more quiet, thus making operation much easier of performance.

DR. SAMUEL ROBINSON, of Boston, referred to some experimental work he had done in the experimental laboratories in Marburg with regard to artificial pneumothorax, and also with regard to the thoraplastic operation; he performed 26 thoraplastic operations upon dogs, with a resulting vastly improved technic.

DR. WILLIAM S. HALSTED, of Baltimore, said that there was reason for hope of cure in cases of aneurism of the abdominal aorta by partial constriction of this vessel, even when the band must be applied above the renal arteries, and cited a case which seemed to prove this assertion. Dr. Halsted has applied an aluminum band to the thoracic aorta about 7 cm. above the diaphragm with the hope of influencing the progress of and relieving the excruciating pain caused by a large aneurism of the upper abdominal aorta, with satisfactory results. He discussed minutely the experimental surgery of the lungs upon dogs, with special reference to the technic, saying that in 21 consecutive thoracotomies there was only one primary infection of the thorax. Positive pressure was employed in all his experiments by means of a very cheap but most effective apparatus devised by Dr. Gatch.

DR. CHARLES A. POWERS, of Denver, said he had been particularly impressed by the work which had been done abroad in cases of surgical interference in pulmonary tuberculosis, especially with reference to nitrogen insufflation in suitable cases. He believes there will be great developments along this line in the near future.

DR. ALBERT VANDER VEER, of Albany, briefly mentioned a paper upon the subject of surgical interference in pulmonary tuberculosis presented by him some years ago. He also referred to a case of recent date in which the thickened pleura was dotted quite extensively with phosphatic deposits, and in which he removed almost completely the entire pleura.

DR. ALEXANDER HUGH FERGUSON, of Chicago, emphasized a simple procedure which he had been using for five or six years, namely, capillary drainage for serous effusion of the lungs and for cases of empyema. He said he had also followed this method of capillary drainage with satisfaction in cases of very large ovarian tumors.

DR. WILLY MEYER, of New York, with regard to empyema spoke in favor of the employment of differential pressure, citing

some very interesting cases. With regard to lung extirpation he said he had found that the important point was the proper treatment of the stump of the bronchus, which he treats on the same basis as the appendix stump; his records show that of 18 total left pneumomectomies 15 have recovered, 3 deaths being due to accidental conditions; in 21 operations there were 17 recoveries; in the removal of the lobes in 6 cases there were 5 recoveries. With regard to the œsophagus, he said there was nothing more difficult than the maintenance of asepsis, and he was of the opinion that all methods demanding suture were to be abolished. He believes efforts should be directed to the implantation of the œsophagus into the stomach rather than to bringing it into apposition with the stomach.

XVIII. THE PREVENTION AND TREATMENT OF THE SEQUELS OF PERINEAL PROSTATECTOMY.

DR. JAMES E. MOORE, of Minneapolis, Minn., read a paper on this subject. He said:

Perineal prostatectomy is a life-saving operation, but a grave one, and should not be undertaken lightly. It is accompanied by a mortality rate of a little over 6 per cent. and over 17 per cent. are either complete failures or are followed by some sequel that makes the operation far from satisfactory. Owing to the age and bad condition of these patients mortality rate must be high. The nature of the operation is such that complications and sequels are bound to occur, but at the present time the mortality rate is too high and the sequels too common. According to the latest statistics 7.4 per cent. of these operations are failures, but in competent hands the patient should always experience sufficient relief to justify the operation, though he may not be completely cured. When a patient continues to suffer pain and tenesmus after the operation it is usually due to a pocketed bladder, diseased kidneys or an incomplete operation.

The prostate is an important sexual organ, and its removal by any route or method is sure to have a decided effect on the procreative powers of the patient. Owing to the reticence and untruthfulness of patients it is impossible to state how often this sequel follows, but it is certain that it occurs so frequently that every patient who is comparatively young in years should have this possible contingency stated to him before the operation is performed.

Injury to the rectum is probably the most frequent complication, often causing death, and when a patient survives he is liable to have a urethral rectal fistula. Unskilful use of fingers, downward pulling by retractors and too slight packing with gauze are the usual causes, and by guarding against these causes this accident should be avoided. When the rectum is torn it should be immediately repaired. This will often fail, but succeeds often enough to justify the effort.

Stricture is a more common sequel than is generally believed, and is due to extensive removal of the prostatic urethra. We expect injuries to the urethra from other causes to result in stricture, and there is no reason why it should not follow this operation. Enough of the upper wall of the prostatic urethra should be preserved to secure an unbroken mucous surface extending from the bladder to the meatus. Extensive dissection of the perineum, especially when cross cuts are made, are conducive to stricture. Projecting portions of the urethra are sometimes left which obstruct the flow of urine by acting as valves.

Dribbling or incontinence is an occasional sequel of perineal prostatectomy and is due to injuries to the neck of the bladder and to the compressor urethræ muscles. Instruments introduced into the bladder to draw the prostate down should be used with the utmost care, lest they injure the neck of the bladder. The compressor urethræ is the important sphincter and should be preserved by entering the prostatic rather than the membranous urethra. The treatment of incontinence when once established seems to be hopeless.

Perineal fistula is a rare sequel and is usually due to the deposit of lime salts, the removal of which relieves the condition.

Epididymitis is an occasional sequel, but is usually of little consequence beyond the discomfort it causes, and is very often due to the injudicious passing of sounds.

XIX. SUPRAPUBIC PROSTATECTOMY.

Dr. Arthur Dean Bevan, of Chicago, Illinois, read a paper with this title.

Dr. Albert J. Ochsner, of Chicago, has been much impressed with the greater ease with which the prostate can be enucleated from above. With regard to the question of hemorrhage, he has been able to overcome this by attaching forceps to the capsule, bringing it down, passing in a rubber tube so that

the bladder would remain empty, then packing the capsule with gauze for twenty-four hours.

DR. ALEXANDER H. FERGUSON, of Chicago, emphasized the great advantages of the perineal route in operations upon the prostate.

DR. JOSEPH RANSOHOFF, of Cincinnati, while in favor of the suprapubic route, thought there were many points in favor of the perineal. He stated that he frequently did a partial prostatectomy, especially in young patients, which he believes can best be performed by the upper operation.

DR. MAURICE H. RICHARDSON, of Boston, said that he did not believe it was possible, by either the perineal or suprapubic route, for the operator to tell how much damage was being done the urethra. He suits the method of removal to the exigencies of the individual case, and is not a firm adherent to either.

DR. STANLEY STILLMAN, of San Francisco, referred to the custom of Sir William Macewen, of performing the suprapubic operation in all cases in which the urine could be rendered fairly healthy, but where this could not be done he performed a double lateral lithotomy incision for purposes of drainage, followed by an interval of a week or ten days, during which time granulation tissue lined the incisions which were made, and the capsule of the prostate retracted; in that time the cut surface of the prostate protruded from the wound, the prostate itself was reduced in size, as the result of complete dissection, and ten days later he would shell out with his index finger each lobe of the prostate, with no bleeding and little danger of infection, insomuch as the urine had become fairly healthy in the interval. Dr. Stillman has followed this plan himself for two years with much better results than he ever obtained from other methods of prostatectomy. His preference is distinctly for the suprapubic operation where the urine is healthy, and for Macewen's method where the urine cannot be rendered healthy prior to operation.

DR. ALEXANDER PRIMROSE, of Toronto, spoke in favor of the suprapubic route, and suggested the possibility of its removal by the transperitoneal route where the urine was healthy.

DR. JOHN B. MURPHY, of Chicago, said he thought there was slight choice between the suprapubic and the perineal route in operating upon the prostate, and that each individual case should be carefully studied and then the method used which would seem to give the best results in that case.

DR. LEONARD FREEMAN, of Denver, was in favor of the suprapubic operation, having also had difficulties with the perineal. He says that he has been able to control the resulting hemorrhage in suprapubic operations, by firm packing of the wound.

DR. JAMES E. MOORE, who is in favor of the perineal route, said he agreed with Dr. Murphy that the operation should be fitted to the case in hand. With regard to partial excision of the prostate he thought this at times was very good surgery. In answer to Dr. Richardson's query as to how to tell when the urethra was injured, Dr. Moore suggested the examination of the specimen after operation.

DR. ARTHUR DEAN BEVAN, in spite of the statements made by the various men discussing the paper, was still of the opinion that the suprapubic route offered the best results. He commended the suggestion made by Dr. Stillman.

XX. FIBROID TUMORS OF THE UTERUS DEMANDING OPERATION.

DR. ARCHIBALD MACLAREN, of St. Paul, Minn., read a paper with the above title, for which see page 287.

DR. MAURICE H. RICHARDSON, of Boston, said he thought there was more danger in a myomectomy than in a hysterectomy, although there was not much danger in either operation. He referred to several of his own cases.

XXI. THE TREATMENT OF TETANUS BY CHLORETONE.

DR. WILLARD H. HUTCHINGS, of Detroit, Mich., read a paper with the above title, for which see page 52.

DR. THEODORE A. McGRAW, of Detroit, spoke with reference to the first case reported by Dr. Hutchings. In this case Dr. McGraw was most careful to thoroughly disinfect the wound, but in spite of these precautions the tetanus developed.

DR. JOHN B. ROBERTS, of Philadelphia, said that he considered the use of chloral, with the addition of the antitetanic serum, in cases of tetanus, very good treatment, but that he was unfamiliar with the composition of chloretone.

DR. THOMAS W. HUNTINGTON, of San Francisco, reported three fatal cases of tetanus in which chloral was used to the limit without other effect than producing the peculiar hue of the skin and somnolence during a portion of the period. He considered the report by Dr. Hutchings as a great advance in the treatment of these distressing cases.

Dr. Algernon T. Bristow, of Brooklyn, spoke with reference to the introduction of the antitetanic serum through the spinal cord, believing this to be indicated in cases of tetanus as much as in cases of meningitis. He also spoke highly of Rogers' method of the introduction of the antitoxin. He emphasized the importance of isolating the patient and keeping from him all noise and light.

Dr. De Forest Willard, of Philadelphia, stated that the only case of tetanus he had ever saved had been kept saturated for 28 days with chloral.

Dr. C. B. G. de Nancrède, of Ann Arbor, said he had been able to save a few cases of tetanus by the use of chloral, but had never seen the slightest effect from the antitoxin administered after the disease had started.

Dr. Nathan Jacobson, of Syracuse, said that he did not believe tetanus could be controlled in the least by amputation, citing instances to prove his belief. With regard to the method of introduction of the antitoxin, he found in a study of many cases that the method made little difference in the results. He has never used chloretone, although he has used chloral, which he does not consider particularly effective; he considers that a good deal of confirmatory experience is necessary to warrant the statement that in chloretone there has been found a means of arresting and curing these very acute cases of tetanus.

Dr. John E. Owens, of Chicago, referred to numerous cases of wounds of the hands and feet during the constructive period of the World's Columbian Exposition, in which no tetanus appeared. These wounds were opened rather freely, curetted more or less, then irrigated with 95 per cent. carbolic acid and a surgical dressing applied.

Dr. J. Ewing Mears, of Philadelphia, spoke of the remarkable success in the treatment of tetanus of puerperal origin which had been obtained in the hospital in Ceylon by the use of the antitetanic serum.

Dr. Hutchings said that chloretone was made from equal parts of chloroform and acetone, put in a test-tube, boiled for a minute or two, to which was then added some finely powdered sodium hydroxide. He considered that chloral had proven unsatisfactory. He agreed that the method of injection of the serum made little difference. He considers the isolation of the patient

most important. With regard to amputation he considers this has little effect upon the course of the disease.

XXII. TRANSPORTATION OF SKIN-FLAPS FROM ONE PART OF THE BODY TO ANOTHER.

DR. J. M. F. FINNEY, of Baltimore, Maryland, read a paper with the above title, for which see page 324.

DR. JOHN B. ROBERTS, of Philadelphia, referred to a case in which a hand was grafted to a toe, and then a nose made out of it; also to a case in which the lip was repaired by flaps taken from the belly. In deformities of the chin and face in which the jaw is drawn down and the lip drawn out, he suggested the attaching of flaps down the back and then wrapping them in front of the patient's throat in the manner of a cravat, which method will sometimes allow the chin to be brought up into normal position.

DR. SAMUEL J. MIXTER, of Boston, referred to the cutting off of the circulation in the flaps by compression with forceps.

DR. GEORGE TULLY VAUGHAN, of Washington, spoke of several cases in which he had successfully employed heteroplasty, and of one unsuccessful case in which he tried to take a piece of skin from the thigh and graft it in the axilla.

DR. WILLIAM S. HALSTED, of Baltimore, spoke of some experiments in transplanting the muscles in dogs from one dog to another, in which great difficulty was encountered in keeping the dogs bound together in order that the flaps might grow. These experiments had finally to be given up because of the impossibility of keeping the dogs quiet.

DR. FINNEY said that the principle of transportation, the term suggested by Dr. Roberts, from one portion of the body to another, is what he wished particularly to emphasize in his paper.

XXIII. SURGERY OF THE LARGE INTESTINE.

DR. WILLIAM J. MAYO, of Rochester, Minn., read a paper with the above title, for which see page 200.

MR. W. ARBUTHNOT LANE, of London, said that his only criticism of Dr. Mayo's technic was that he considered it much easier to divert the ileum into the sigmoid flexure, as then one could remove as much of the big bowel as desired. He found that if he ran the end of the ileum into the splenic flexure, at the end of some months he had to deal with a dilated ileum.

Dr. J. C. Bloodgood, of Baltimore, spoke with reference to the pathology of carcinoma of the large intestine. Anatomically and pathologically the evidence favors a very extensive resection of the large intestine because the tendency of the new growth is to infiltrate along the wall of the bowel and not into the mesentery with extensive involvement of glands. He suggests instead of the end-to-end anastomosis a large lateral anastomosis with the closed ends of the bowel protruding from the wound; this method has decreased his mortality rate greatly.

Dr. John H. Gibbon, of Philadelphia, referred to 10 cases he had had of resection of the colon for cancer and tuberculosis, one case of which is now well at the end of four years. In this case the colon was resected from the hepatic flexure to the sigmoid. Another case is well eighteen months after resection of the cæcum and ascending colon for cancer. He said that he had frequently made the mistake of doing an immediate resection in case of complete or partial resection where a drainage operation would have been better. The temptation to do the immediate resection and anastomosis is very great in some of these cases, but the operator should never yield to it.

Dr. Samuel J. Mixter, of Boston, suggested another method of anastomosis much like that suggested by Dr. Bloodgood—tying a tube into each open end of the bowel, and then by just a few stitches stitching the bowel together in the position suggested by Dr. Bloodgood, making a sort of double gun-barrel which is brought outside.

Dr. William J. Mayo thought the suggestion of Dr. Bloodgood an extremely good one which he should put into practice. He experimented with end-to-side anastomosis; three cases did well, and then two were lost from leakage. He thinks Dr. Bloodgood's method of bringing the ends of the bowel outside the wound would obviate the leakage.

XXIV. SUDDEN DEATH.

Dr. John Bapst Blake, of Boston, Mass., read a paper upon cases of sudden death occurring during physical exertion or psychic shock, for which see page 43.

Dr. Frederick H. Gerrish, of Portland, Maine, made reference to the first case in which chloroform was to be administered as an anæsthetic. The patient, just before the administration of the chloroform, expired on the table, and he is of the

opinion that had any of the drug been given it would have delayed its use as an anæsthetic for many years,—but as was very evident, it could not be blamed for the fatal result in this case.

XXV. ANEURISMS IN YOUNG PEOPLE.

DR. THEODORE A. McGRAW, of Detroit, Mich., read a paper with the above title, for which see page 59.

XXVI. RESECTION OF THE SCIATIC NERVE; NEUROPLASTY.

DR. KENNETH A. J. MacKENZIE, of Portland, Oregon, read a paper with the above title, for which see page 295. He also presented the patient whose case was reported and demonstrated the end results of the procedures described.

DR. JOSEPH C. BLOODGOOD, of Baltimore, said that the most interesting part of the case reported was its surgical aspect, as it represents one of the longest resections of the sciatic nerve on record. In his examination of sections of the tumor he was able to find the congenital residue of the multiple tumors now apparent on the patient. He said there is definite proof that many tumors of congenital origin of years' duration, clinically and histologically benign, may at any period become malignant.

DR. RUDOLPH MATAS, of New Orleans, referred to a case reported by him before the association in 1898 in which there was a huge tumor, even ¹·/ger than that removed by Dr. MacKenzie. Dr. Matas did not, however, try to restore the sensibility of the parts, as Dr. MacKenzie had done so remarkably. Dr. Matas' patient developed a trophic ulcer of the heel, but after this had healed he was able, with the aid of a brace and a stick, to get along very well.

DR. MacKENZIE said that in trophic changes following injuries to the nerve, where it is impossible to restore motion and sensation, it is still possible, by making a flap operation, to prevent or stop the trophic disturbance.

XXVII. THE OPERATIVE TREATMENT OF FRACTURES.

DR. JOHN B. WALKER, of New York, read a paper with the above title.

MR. W. ARBUTHNOT LANE, of London, said he thought there was a certain amount of misunderstanding regarding the overlapping of fragments, stating that he had never seen a case where the shortening could not be completely overcome. He does not

consider wire very efficient in the suturing of fragments. He uses strong plates which will stand a strain of 448 pounds, and which are attached by small screws.

DR. T. W. HUNTINGTON, of San Francisco, laid special emphasis upon the value of the X-ray records in dealing with fractures, saying that he kept a complete record of every case, from start to finish.

DR. CAREY, of San Francisco, presented some X-ray plates of cases of fracture showing the perfect reposition obtained by means of the staple, an instrument recommended by Mr. Lane some years ago. His pictures also represented the small amount of callus produced when the fragments are perfectly reduced.

DR. CHARLES H. MAYO, of Rochester, Minn., said that in his opinion we should follow the suggestions of those who obtained the best results in the treatment of fractures, rather than continue with the old methods which often proved so unsatisfactory.

XXVIII. OBSERVATIONS ON THE INEQUALITIES OF THE RIGHT AND LEFT FEMORA.

DR. ALGERNON T. BRISTOW, of Brooklyn, New York, read a paper with the above title, for which see page 313.

DR. T. W. HUNTINGTON, of San Francisco, said that he had gone over several cases with regard to the inequalities of the right and left femora. He expressed his appreciation of Dr. Bristow's very carefully prepared paper.

DR. ALBERT VANDER VEER, of Albany, thought that Dr. Bristow's methods of measurement would be a great help in court in cases of malpractice.

DR. FREDERICK P. GERRISH, of Portland, Me., spoke of measurements made thirty years ago of students at Girard College, Philadelphia, by Dr. Martin, who used a very ingenious and accurate apparatus. He arrived at substantially the same results as Dr. Bristow, that there are great variations in the two lower limbs. He also referred to a method of measurement which he used. First, he adjusts the patient as precisely as possible upon a hard mattress or firm bed, having the head held with as nearly as possible perfect adjustment, have the patient take a tape between his front teeth exactly in the middle, and then he measures to the internal malleoli of the right and left side. By this method there is no chance of the shifting of the finger, as when the tape is held on the skin, and he has found it very useful indeed.

DR. ROBERT W. JOHNSON, of Baltimore, said that in the taking of these measurements it was his opinion that the further one got from the pelvis the more likely they were to encounter changes from respiration and from the shifting of gas in the abdominal cavity. The measurements taken from the anterior superior spine would therefore appear to him to offer the best results.

MR. W. ARBUTHNOT LANE, of London, referred to a report made by him some twenty-five years ago regarding this subject in bodies at the Guy's Hospital. With all the shortening in these cases he found the spine perfectly straight, which was Nature's compensation. With regard to the use of these measurements in cases of malpractice he could not agree with Dr. Bristow in their accuracy.

DR. WILLIAM W. KEEN, of Philadelphia, said that he always measured, not from the anterior superior spine to the end of the malleolus, but just the reverse, attaching the fixed end of the tape at the end of the malleolus, but previously by careful manipulation determining what is the centre of the anterior superior spine and marking it. He then stretches the tape from the internal malleolus up to and over, but never touching, the skin over the anterior superior spine, thus reaching a much more accurate measurement than by any other method.

DR. RICHARD H. HARTE, of Philadelphia, said it was his opinion that no surgeon would rely upon simply one measurement, but would take them by various methods and check them up, thus being sure of the accuracy of his findings.

DR. BRISTOW said that he had recently seen several cases in which it was absolutely impossible to bring the limbs together by any amount of weight. He considers the X-ray the best and practically the only method of determining the relative proportions of the two limbs. He emphasizes the fact that the disproportion in the limbs may be erroneously treated by the use of too heavy weights, probably with disastrous results.

XXIX. STRANGULATED RETROPERITONEAL HERNIA.

DR. WILLIAM B. COLEY, of New York, reported a case of "Strangulated Retroperitoneal Hernia of the Intersigmoid Fossa," for which see page 238, and a case of "Interparietal Ventral Hernia at McBurney's Point," for which see page 246.

XXX. VESICO-INTESTINAL FISTULA.

DRS. F. W. PARHAM and JOSEPH HUME, of New Orleans, La., read a paper with the above title, for which see page 251.

XXXI. COMPLETE DETACHMENT OF THE FACIAL BONES FROM THE CRANIUM.

DR. CHARLES A. POWERS, of Denver, Colo., reported a case of the above character, for the description of which see page 73.

XXXII. MASSIVE KELOID OF FACE AND HANDS.

DR. CHARLES A. PORTER, of Boston, Mass., reported a case of remarkably massive keloid development, and presented a series of photographs depicting the condition. For this paper see page 332.

XXXIII. THE OLD AND THE BEGINNING OF THE NEW IN SURGERY.

DR. J. EWING MEARS, of Philadelphia, presented an historical memoir with the above caption, which was read by title. For this memoir see page 23.

XXXIV. SUGGESTIONS FOR THE OPERATIVE CORRECTION OF SYPHILITIC AND OTHER DEFORMITIES OF THE NOSE.

DR. JOHN B. ROBERTS, of Philadelphia, presented this paper, which was read by title. It will appear in a future number of the ANNALS OF SURGERY.

A BARGAIN IN CHAIRS AND TABLES

Our readers' attention is called to an exceptional bargain inserted among our advertising pages by Sharp & Smith of Chicago. Any physician who wishes to equip himself with a strictly up-to-date, first-class chair should not fail to "get in" on this offer. This well-known firm carries nothing but strictly first-class, up-to-date, guaranteed instruments, and we wish to assure our readers anything purchased from them is backed by a reputable house.

ANTISEPSIS OF THE INTESTINAL CANAL

The griping pain and flatulence which accompany bowel and stomach complaints, particularly during the heated term, are so readily overcome and controlled by the timely administration of one or two Antikamnia & Salol Tablets, repeated every two or three hours, that it behooves us to call our readers' attention to the grand efficacy of this well-known remedy in these conditions. The above doses are, of course, those for adults.

Children should be given one-fourth tablet for each five years of their age. When the attack is very severe, or when the disturbance is evidenced at or near the time of the menstrual period, we find it preferable to give two Antikamnia & Codeine Tablets, alternately with the Antikamnia & Salol Tablets.

The latter tablets promptly arrest excessive fermentation and have a pronounced sedative effect on the mucous membrane, of the bowels and stomach, and will check the various diarrhœas without any untoward effect.

LYSOL IN SURGERY

1. Sterilization of the hands of the surgeon, his assistants, and nurses. A 3 per cent. solution in hot water is used with a nail-brush. The hands and forearms are scrubbed thoroughly for five minutes with a nail-brush, paying particular attention to the nails. Then the nails are cleaned, and afterwards they are scrubbed for three minutes more in a fresh 3 per cent. solution and rinsed with sterile water.

2. For a hand-douche to be used during the operation a 1 per cent. solution in hot water will be satisfactory for removing blood, or a 2 per cent. solution when the hands have been soiled by contact with pus, a nail-brush being used.

3. For preparing the field for operation and sterilizing the skin, the surface may be thoroughly washed with a 2 per cent. solution in hot water, using a wad of gauze or a nail-brush, and taking care not to abrade the surface. Then a pad composed of several layers of gauze, and wet with a 1 per cent. solution, is applied and held in position with a bandage. This is to be kept in position for several hours, or overnight. When the patient is placed on the operating-table this is removed, and the surface is again washed thoroughly with a 2 per cent. solution and a nail-brush. Afterwards the surface is rinsed with sterile water, and also with alcohol and ether, if desired.

4. Recent wounds may be washed or irrigated with a 1 per cent. solution in hot water. For cleansing chronic sores, ulcers, etc., a 2 per cent. solution may be used, and for irrigating abscess cavities the same strength solution will be satisfactory.

5. Lysol may also be used for cleansing and disinfecting the walls and floors of operating-rooms and rooms in private dwellings to be used for operating.

6. Lysol is effective also in preparing and rendering aseptic surgical dressings, boiling them in a 1 per cent. solution for five or ten minutes.

THE HEATH MATERNITY CORSET

The Heath Maternity Corset is made with a long, graceful front which entirely covers up and supports the abdomen. The upper part is full and roomy so as to support without giving any harmful pressure.

The entire front of the corset is soft, being fastened with glove-buttons instead of steel clasps. The little boning is watch-spring Walohn, very pliable and light, with just enough stiffness to hold the garment in shape. The double row of lacing in front permits adjustment and enlargement of the entire corset, thus furnishing a perfectly fitting garment throughout the entire period.

The construction in back is equally important, as it furnishes the support that is required to relieve the "backache" so frequent during pregnancy.

The double adjustable elastic straps in back, a unique feature of all Heath Corsets, accommodate themselves freely to every movement. Whether standing, sitting, walking, or riding, this corset gives perfect support and freedom of movement.

Pomeroy Company, of 34 East 23d Street, New York, says it is a pleasure to recommend and sell the Heath Maternity Corset on account of the expressions of approval given by every customer immediately after trying one on.

The Heath Maternity Corset merits this approval because it is the only maternity garment which combines the features of comfort and beneficial support, together with a decided improvement in the personal appearance of the wearer.

INFLAMMATORY DIARRHEAS

By William Edwards Fitch, M.D.,

Lecturer on Surgery, Fordham University School of Medicine, New York City.

In discussing this subject we will speak of inflammation of the small and large intestines as a single disease. And without taking up the reader's valuable time in discussing etiology or symptomatology we will proceed at once to consider the medical treatment. The first step in this direction is to thoroughly evacuate the intestinal contents, and for this purpose no drug or combination of remedies has in our hands given the satisfaction that calomel has. Usually for a child of two years three grains are ordered rubbed up with sugar of milk and made into three powders and one administered every hour until all are taken, after which an old-fashioned dose of castor oil is given, which will produce several copious actions from the bowels. Then I order a high enema composed of the following: Glyco-Thymoline one part, lime water one part, and distilled water two parts; about one pint of this solution is thrown well up into the bowel through a long rectal tube and allowed to remain until evacuated.

Experience has taught me that Glyco-Thymoline exerts a beneficial action over the inflamed intestinal mucous membrane. For a child under two years old I order thirty to forty drops in a tablespoonful of water, administered internally every four hours, and have found that it acts as an intestinal antiseptic and astringent, not affecting the normal digestive juices.

PERFECTLY SATISFIED

I have satisfied myself that Glyco-Heroin (Smith) is the best respiratory sedative and expectorant I have used so far. It is well worthy a trial. Glyco-Heroin (Smith) sooner or later will be indispensable, and will be a welcome addition to the "armamentarium" of every physician. A case may not be amiss:

Mrs. H., age 39, operated on for large ovarian cyst. Tenth day after operation, had a chill and temperature rose to 103.2° F. The wound was immediately examined and found in good condition, free from pus. Three hours later patient complained of pain in left side of chest and coughed considerably. Pulse 108. She was put on Glyco-Heroin (Smith) at once, drachm doses every two hours. A few rales had been discovered at base of left lung. The following morning

pain had ceased and there was no more co[ ] Lungs negative. She made an uninterrup[ ] recovery. I believe this to be an abo[ ] pneumonia.—Chas. L. Ashley, M.D., in *[ ] ical "Review of Reviews,"* November, 1901

CHRONIC GASTRITIS AND UL[ ]

In chronic gastric inflammation and ulc[ ]ation the treatment should consist in [ ] close attention to diet and secretion, [ ] medicines applied symptomatically as in[ ]cated. In severe cases absolute rest in [ ] should be enforced until the symptoms [ ] subsided. The food must be easy of [ ]tion and non-irritating, taken in small [ ]tities and often. If the case be an exter[ ] one, rectal feeding should be adopted u[ ] the stomach is able to retain food comfo[ ]ably. It is largely conceded now by the p[ ]fession that Bovinine is the nourishme[ ] tacitly indicated in all such cases, using an[ ] where from ten to thirty drops, according [ ] the case, every one or two hours, in milk [ ] has been peptonized, water, or cold b[ ] ill [ ]

From this administration, it has been [ ]clusively proven that the stomach gets [ ] most absolute rest, even while receiving [ ] full nourishment; and so the most p[ ] nutrition of the system, including the [ ] eased part of the stomach itself, is kept u[ ] without interruption, without irritation, an[ ] without injurious functional labor.

HERNIA

Every physician has some patient contin[ ]uously bothering him on account of a diffi[ ]cult case of hernia that cannot be successfull[ ] retained by an ordinary truss. Such ca[ ] are a nuisance to physicians. Every other day a man will come in and say, "My truss bothers me, Doctor; it will not hold. What shall I do?" The doctor tries to make another adjustment of the truss, but the hernia, being an aggravating case, continues to give trouble. Many physicians resort to an operation as the only way out, though they realize that many cases are not physically able to stand an operation.

The Pomeroy Company, at 34 East 23rd Street, are making a special appeal for such cases. They claim to have perfected a truss that will retain the hernia under all circumstances, both comfortably and securely. They wish to take all this trouble away from the physician, and especially solicit difficult cases of hernia that have heretofore been considered as unholdable.

LIPPINCOTT'S MEDICAL PUBLICATIONS

THE GENERAL PRACTITIONER. The physician who wants to have in his library a book that is broader and fuller than any now on the market; one that combines Histology, Embryology, Descriptive Anatomy, and Applied Anatomy, as well as an Atlas—in a word, something in which to find the whole tale, must have Piersol.

ILLUSTRATIONS. Absolutely no expense has been spared in illustrating Piersol's Anatomy. No limit has been placed on the number or cost of the illustrations, the sole idea being to have it the most richly illustrated text-book on the market.

In almost every case special dissections or preparations were made, and the drawings taken direct from nature, giving faithful, honest, conscientious reproductions, resulting in the most remarkable, accurate, and artistic anatomical illustrations.

THE AUTHORS' SUBJECTS.

The preparation of this work was undertaken with three chief considerations in mind. 1. The presentation of the essential facts of human anatomy by a concise descriptive text, sufficiently comprehensive for a thorough understanding of the gross appearances and relations of the various parts of the human body, and their structure and development. 2. Adequate emphasis and explanation of the many and varied relations of anatomical details to the conditions claiming the attention of the physician and surgeon. 3. The elucidation of such text by illustrations that should portray actual dissections and preparations with fidelity and realism.

Dr. Thomas Dwight has written the description of the skeleton, including the joints, and that of the gastro-pulmonary system, and of the accessory organs of nutrition.

Dr. Carl A. Hamann has contributed the account of the cerebro-spinal and sympathetic nerves.

Dr. J. Playfair McMurrich has supplied the systematic description of the muscular and of the blood- and lymph-vascular system.

Dr. George A. Piersol has written the introductory, histological, and embryological paragraphs throughout the work, and contributed the description of the central nervous system, including the deep relations of the cranial nerves, of the organs of special sense, of the carotid, coccygeal, and aortic bodies, and of the uro-genital system.

Dr. J. William White, widely known both as a surgeon and a teacher of surgery, has, under the head of Practical Considerations, pointed out with unusual force the relations of anatomy to the requirements of the practitioner, and associated anatomical facts with those conditions, resulting from injury or disease, that these facts elucidate, presenting, in connection with each organ or system, enough facts illustrative of the dependence of the diagnostician and practitioner upon anatomical knowledge to awaken interest and to combat the tendency to regard anatomy as something to be memorized during student days and forgotten when examinations are over. Even when such facts do not seem at a first glance to come within the scope of a text-book of anatomy, it will be found that a careful comparison of this text with the descriptive portion of the book will show a real and practical relation between them—a relation which, once established in the minds of the student and the physician, will make it easier for the former to learn his anatomy and for the latter to remember and apply it.

The illustrations, a matter of fundamental importance, have received most conscientious attention. In the completion of this labor the editor has been most fortunate in having the assistance of Dr. John C. Heisler, to whose skill and tireless enthusiasm he is indebted for the admirable dissections from which most of the illustrations of the muscles, blood-vessels, nerves, perineum, and inguinal region were drawn.

Dr. Gwilym G. Davis has supplied the dissections for the drawings relating to the Practical Considerations.

In addition to the numerous dissections and preparations made especially for the illustrations, advantage has been taken of the rich collections in the museums of the Medical Department of the University of Pennsylvania, of the Harvard Medical School, and of the Wistar Institute of Anatomy.

Records of the dissections, in many cases life size, were made in water-colors, chiefly by Mr. Hermann Faber, whose renditions combine faithful drawing with artistic feeling to a degree unusual in such subjects. The records not made by the last-named artist are from the brush of Mr. Ludwig E. Faber. The translations of the colored records into black and white, from which the final blocks have been made, as well as the original drawings of the bones and of the organs, have been made by Mr. Erwin F. Faber. Mr. J. H. Emerton drew the joints, as well as some figures relating to the gastro-pulmonary system, from dissections and sections supplied by Professor Dwight.

The numerous illustrations representing the histological and embryological details, and in addition the sections of the brain-stem under low magnification, are by Mr. Louis Schmidt. In all cases sketches with the camera lucida or projection lantern or photographs have been the basis of these drawings, the details being faithfully reproduced by close attention to the original specimens under the microscope.

LIPPINCOTT'S MEDICAL PUBLICATIONS

Kelly

Appendicitis

By HOWARD A. KELLY, M.D.
Professor of Gynecology in the Johns Hopkins University, Baltimore.

Imperial octavo. 500 pages. 215 illustrations, some in colors and three lithographic plates. Cloth, $6.00.*

THIS work is needed to place in convenient form in the hands of that large and most important class of the medical community, the general practitioner ; a work which will present succinctly and clearly,' as well as from a practical standpoint, all that he needs to know about this, which clinically is one of the most important organs in the body. It is supposed hardly a week goes by without every busy physician being consulted by one or more anxious patients as to whether he or she has appendicitis and requires an operation.

In this work Dr. Kelly considers in particular the treatment to be adopted in those cases which are not manifestly operative from the start. He explains fully with text and illustrations the details of the operation for appendicitis and the after-treatment.

As only a comparatively few persons are conveniently situated for securing consultation, it is not infrequently necessary for the general practitioner to undertake the operation himself.

The discussion of the history and anatomy in this edition is extremely brief. On the other hand, the pathology, etiology, clinical history, and diagnosis are treated at length, and an entirely new chapter on the value of the leucocyte count in the diagnosis of appendicitis by Dr. Charles E. Simon has been added.

The section on senile appendicitis by Dr. Walter L. Burrage is included in the chapter on appendicitis in childhood.

The beauty and the accuracy of the illustrations have never been surpassed, most of them having been taken from the author's previous extensive work for the specialist written in conjunction with Dr. Hurdon. The two pages of aphorisms in appendicitis for the general practitioner cause vitally important facts to sink into the memory in such a way as never to be forgotten.

ANNOUNCEMENT

GENERAL INDEX TO THE FIRST FIFTY VOLUMES OF THE ANNALS OF SURGERY

IN response to the repeated requests which have been received from many sources during recent years for a General Index to the Annals of Surgery from the beginning of its publication, the publishers announce that they propose to signalize the completion of the fiftieth volume of that periodical by issuing a complete index to the entire series of fifty volumes. It is estimated that this will make an octavo volume of about 300 pages.

Such an index will unlock for ready reference a series of volumes in which are contained many of the most important contributions to surgery made by English-speaking surgeons during the past twenty-five years. In addition to these, it will make accessible to the surgeon English translations in abstract of many other important papers in all tongues.

The price of this Index Volume will be *three dollars and fifty cents including delivery charges.* In order that they may have some criterion as to the size of the edition of the Index to be printed, the publishers request that all who desire the Index favor them with a statement of that fact at the present time; for this purpose a blank order is attached, which subscribers are respectfully requested to fill out and return.

ANNALS OF SURGERY.

ANNALS OF SURGERY
227 SOUTH SIXTH STREET, PHILADELPHIA

Gentlemen:—When the "GENERAL INDEX to the First Fifty Volumes of the Annals of Surgery" is ready, please send, express prepaid, ... cop.... to the following address, for which I agree to pay three dollars and fifty cents on delivery.

ORIGINAL MEMOIRS.

AN ANALYTICAL AND STATISTICAL REVIEW OF ONE THOUSAND CASES OF HEAD INJURY.

(Continued from vol. xlix, page 613.)

BY CHARLES PHELPS, M.D.,

OF NEW YORK CITY,

Surgeon to Bellevue and St. Vincent's Hospitals.

SYMPTOMATOLOGY.

I.—CONSCIOUSNESS AND MENTALITY.—The primary mental disorder was ascertained from the ambulance record, or, if this were impossible, was assumed from the patient's condition upon immediate admission to the hospital; and as here formulated, loss of consciousness might be either transient, considerably prolonged, or permanent.

CASES IN WHICH THE PATIENTS WERE:

Entirely unconscious, Fatal, 318; Recovering, 224......... 542
Practically unconscious, Fatal, 30; Recovering, 46.......... 76
Conscious with mental state normal, Fatal, 80; Recovering,
    209 289
Conscious with mental state abnormal, Fatal, 24; Recover-
    ing, 28 52
Not mentioned 41
                                                          ———
       Total 1000

The term "practically unconscious" is used for want of one that is better, and indicates a condition in which there is

no manifestation of consciousness except a recognition of painful sensations, or one in which the patient can only with difficulty be momentarily aroused.

The primary mental disorders were: apathy; delirium, mild or active, muttering or alternating with stupor; and a deficient intelligence as manifested by an inability to realize surroundings, the fact of injury, or even personal identity.

The cases in which no mention is made of primary mental conditions are those of patients transferred from other institutions; and a larger number, usually of gunshot wounds, in which the patient was·found unconscious with no obtainable earlier history. It seems probable that the primary condition was in the majority of cases one of unconsciousness in both the second and third classes.

Primary unconsciousness was followed by its immediate loss in about 35 per cent. of fatal cases, and in general was always lost before the close of life. The only exceptions were in cases of intercurrent disease, or from apnœa from the supervention of pulmonary œdema or compression of the respiratory ganglia. In a limited number of cases, as of meningitis, prolonged delirium, or mental decadence, the loss might be considered indirect and chargeable to an exhaustion of the vital powers; but usually and characteristically it occurred as a direct result of the traumatism. A statement made after an earlier study of this subject, that "in a majority of cases unconsciousness is profound, or at least complete, from the receipt of injury to the close of life," requires correction. In fact, this proportion has been found to be rather less than 50 per cent. of the fatalities noted. In 39 per cent. of cases consciousness was immediately replaced by some mental disorder other than delirium.

Whatever might be the primary mental condition, delirium was the most frequent of all the later symptoms, being observed in more than 50 per cent. of that one-half of the cases in which unconsciousness was not permanent; and as a primary symptom it was the most frequent of the mental derangements when consciousness was retained.

The secondary mental changes in fatal cases were not essentially different whether consciousness was retained or lost; there was no constancy in either event. An interval of consciousness and rational intelligence following primary unconsciousness was infrequent; and an interval of stupor, apathy, or mental decadence, though oftener noted, was still confined to a very limited number of cases.

The secondary mental changes in cases which ended in recovery differed with the primary mental state. If it were one of unconsciousness, consciousness might be restored after an interval of moments only, or it might be after an interval prolonged for many days. In the first instance it was usually a direct restoration of rational intelligence; in the second it was often gradual and through stages of mental obscuration or derangement. In either event the final mental condition might be one of permanent impairment. If the primary state were one of unconsciousness and rational intelligence a reference to the tabulation of cases will show that recovery occurred in 70 per cent., as did death in 60 per cent., of those primarily unconscious, but the fatalities were still so many that the mere fact of primary consciousness or unconsciousness can be of itself no guide in prognosis. In a large number of cases which recovered, especially of fractured vertex or moderate general contusion, there was no further mental change. In others, in which hemorrhages or morbid nutritive changes in the cerebrum or its membranes were progressive, the same secondary forms of consciousness or mental derangement necessarily occurred as with the same structural alterations when consciousness was primarily lost. If primary consciousness was characterized by delirium or other mental derangement the termination was usually delayed, and the chances of life and death were nearly evenly balanced.

The relations of these varying phases of consciousness and mentality to underlying anatomical lesions will be illustrated here by some brief abstracts of cases; these like others to follow, while selected with direct reference to some one point, will incidentally illustrate other conditions to which attention will be called.

CASE XXX.—*Primary and Permanent Unconsciousness. Necropsy.*—An unknown man was found unconscious in the street with stertor and general muscular rigidity. He was in profound coma on admission to the hospital, with muscles relaxed and reflexes absent, and with no hemorrhages and no evident external injuries. Temperature 97.4°; pulse 52; respiration 18; right pupil contracted and without reaction; left pupil normal. Coma continued, and temperature rose progressively to 108.2° at death eighteen hours after admission; respiration then 60, and pulse imperceptible.

Lesions.—Fracture extending from left inferior parietal region and above the petrous portion into the floor of the left middle fossa; soft epidural clot, 4 by 3 inches, and 2 inches thick, compressing laterally the left frontal, temporal, and parietal lobes, and extending to, but not into basal fossa; pial hemorrhage thinly covering vertex and forming clots in both anterior and both middle fossæ, perceptibly compressing the under surface of both anterior lobes; subcortical laceration in right posterior inferior parietal region; limited contusion of left temporal convolutions; moderate general hyperæmia and œdema confined to upper part of cerebrum.

CASE XXXI.—*Primary and Permanent Unconsciousness. Necropsy.*—The patient fell down a flight of steps and was made primarily unconscious. On immediate admission to the hospital: temperature 102.2°, pulse 130, respirations 36; pupils normal; lack of vesical control; Cheyne-Stokes respiration; patellar reflex absent. Second day: pupils contracted and immovable; temperature 101.8°; coma profound. Fourth day: temperature 104.2°; progressive asthenia; no other change. Died.

Lesions.—No fractures; no epidural hemorrhages; two small pial hemorrhages, in right frontal and right parietal region respectively; limited contusion of right frontal lobe underlying the pial hemorrhage, and extending through cortex and subcortex to centre of lobe with numerous punctate extravasations; general cerebral contusion.

CASE XXXII.—*Primary Unconsciousness with Subsequent Delirium. Necropsy.*—The patient was knocked down by a trolley car and rendered primarily unconscious. On admission to the hospital: temperature was 99.6°; pulse, 80; still unconscious. Some hours later he was restless and could be aroused momen-

tarily; incoherent. In twelve hours he was fully conscious and delirious; pupils normal. For first ten days temperature ranged from 101° to 99.4°, and pulse from 80 to 88; rectal control lost: comprehension slow; descending optic neuritis discovered. Still later: active delirium which continued twenty-five days; rectal and vesical control variable; temperature rose to 103.6° and pulse to 128; alternate delirium and unconsciousness. Died on the thirty-fourth day.

Lesions.—No fractures; no hemorrhages; laceration of right frontal and temporal lobes; marked cerebral hyperæmia and œdema; cloudy subarachnoid effusion.

CASE XXXIII.—*Primary Normal Consciousness.* The patient inflicted upon himself a gunshot wound of the head. He did not fall or lose consciousness for four or five minutes. On admission to the hospital: coma profound; left pupil dilated; respiration became Cheyne-Stokes and both pupils widely dilated and immovable; temperature 99°.

Operation.—Large epidural hemorrhage discovered with laceration of the arteria meningea media which was controlled by pressure. Death two hours later.

CASE XXXIV.—*Primary Normal Consciousness. Necropsy.* —The patient fell from a loft to the stage of a theatre and was dazed but able to walk about and converse. Thirty minutes later while in a cab he became drowsy, and then somnolent and by his own direction was at once taken to the hospital. On admission: entirely unconscious; temperature 96°; pulse 68; right pupil contracted; left pupil dilated. Death in four hours from time of injury. Temperature 97°.

Lesions.—No fracture; epidural clot, 3½ by 3½ inches, on the right side of the cerebrum from rupture of arteria meningea media; no other hemorrhage or laceration; moderate cerebral hyperæmia and œdema.

CASE XXXV.—*Primary Consciousness. Necropsy.*—On admission to hospital patient conscious and able to walk when supported, but unable or unwilling to speak: temperature 98°: muscles spastic; pupils irresponsive, and the left dilated: slight mastoid œdema and ecchymosis. Second day: apathetic; face flaccid; rubbed his face with his hands but made no response to efforts to rouse him: temperature 101°. Third day: in the morning, condition unchanged: in the evening, cyanosis and pulmonary œdema; patient unconscious: death fours hours later.

Lesions.—Fracture of cranial base involving jugular foramen; thrombus in corresponding lateral sinus; no epidural or pial hemorrhage; laceration of left cerebellar and occipital lobes with cortical hemorrhage in posterior basal fossæ; general capillary extravasation into pia mater; limited area of meningitis over each frontal lobe; thickening of meninges; punctate extravasation in left parietal and occipital lobes; laceration of right frontal lobe; hemorrhagic softening of the right frontal cortex.

Case XXXVI.—*Primary and Permanent Delirium. Necropsy.*—The patient fell ten feet to the sidewalk and became at once actively delirious. On immediate admission to the hospital: still delirious; condition not alcoholic; temperature 99.2°; pupils normal; hemorrhage from right ear. In nine hours he became still more wildly delirious; temperature 101.4°, and so continued through the night. Second day: temperature 102°; vesical control lost; still delirious. Third day: progressive rise of temperature from 102° to 107.2°; delirium alternating with stupor. Death on the fourth day.

Lesions.—Fracture through right middle basal fossa into orbital plate; small epidural and pial hemorrhages in right parieto-temporal region; excessive cerebral œdema and moderate hyperæmia; large serous exudation into meshes of pia mater and into subarachnoid space. Some arachnoid opacity.

II.—Temperature.—Variations of temperature are perhaps the most significant of the indications of intracranial injury; and considered in connection with the phenomena of consciousness may point directly to the nature and extent of lesion, and often to its probable result.

Temperature above 98°, and not exceeding 99°, will be considered normal.

PRIMARY TEMPERATURE.

92° to 98°:
    Fatal cases 104
    Recoveries 139
98° to 99°:
    Fatal cases 80
    Recoveries 145
99° to 100° inclusive:
    Fatal cases 76
    Recoveries 95

100° to 101° inclusive:
    Fatal cases 21
    Recoveries 38
101° + :
    Fatal cases 6
    Recoveries 13
102° — :
    Fatal cases 6
    Recoveries 2
102° + :
    Fatal cases 14
    Recoveries 0

In 42 cases the earliest temperature taken was from 102°
to 105°, but in 28 of these it was taken after an interval of
from twelve hours to six days from the time of injury and
could in no sense be considered primary. These and similar
cases were excluded from tabulation. The 14 cases remain-
ing were brought under immediate observation.

The one case in which primary temperature reached 105°
was that of a man who had jumped from a window while in
the delirium of pneumonia.

HIGHEST TEMPERATURE.

100° and below:
    Fatal cases 32
    Recoveries 142
100° to 101° inclusive:
    Fatal cases 23
    Recoveries 121
101° + to 102° inclusive:
    Fatal cases 12
    Recoveries 61
102° to 103° inclusive:
    Fatal cases 22
    Recoveries 48
103° to 104° inclusive:
    Fatal cases 44
    Recoveries 28
104° to 105° inclusive:
    Fatal cases 48
    Recoveries 8

The temperature of 105° in a single case of recovery
occurred on the sixth day and was coincident with an attack
of some severe intestinal disturbance.

105° to 106° inclusive:
    All fatal cases.................................... 51
106° + to 107° inclusive:
    All fatal cases.................................... 36
107° + to 108° inclusive:
    All fatal cases.................................... 32
108° + to 109° inclusive:
    All fatal cases.................................... 9
109° + to 110° inclusive:
    All fatal cases.................................... 4

It will be observed that when the highest temperature did not exceed 103° the number of recoveries was greatly and favorably disproportionate to that of fatalities; and that when it was above that point the comparative number of fatalities was in still higher percentage than were the recoveries in the former cases. The highest temperature was not always noted at the same period in the progress of different cases, but was usually attained during the last day of life, and was invariably the case when its maximum was at or above 107°. In a single instance a maximum of 108.2° was reached as early as fifteen hours before death, and was without later remission. The rise in temperature was sometimes progressive, either from the beginning or from some later period to the end of life; but was oftener erratic, varying from hour to hour or from day to day within comparatively narrow limits; or perhaps receding from some high degree even to normal or subnormal and after an interval, long or short, again rising to or above its previous maximum. It was the rule rather than the exception that a marked increase occurred at the very end of life, or even in articulo mortis, and this was not infrequently continued for from fifteen to thirty minutes post mortem, and might be fractional or even extend to several degrees. In a case previously reported (Phelps—"Injuries of the Brain," Case 121) the final temperature was 98.6°, and thirty minutes post mortem rose to 109°.

An attempt was made to study the relation existing between opposite axillary temperatures, but was abandoned partly on account of paucity of results, and partly on account of the

impossibility of obtaining efficient co-operation of hospital internes. The cases examined included a certain number both of those which proved fatal and of those which recovered. In general there was a want of correspondence in elevation, usually fractional, but occasionally extending to 1° or 2°, and the higher temperature usually, though not always, continued to be manifest upon the same side of the body. The observations were made for periods extending from one to thirty days. There was no absolute consistency in the amount of elevation or in the side upon which it was exhibited, not even during the same day; and no relation could be established between the asymmetry and the causative lesion except that there was always a general cerebral contusion; and there was none between the side of high temperature and the side on which a limited lesion existed. In every case examined temperatures taken in opposite axillæ were as a rule at all times unsymmetrical, but in no case were they at variance in every observation made.

The most salient fact observable in the tabulation of cases is that with a primary temperature above 102°, or with a subsequent temperature of 105° or above, recovery has never occurred. This is true not only of the cases tabulated, but of the whole 1000 which form the basis of this paper. An apparently exceptional instance of such recovery when temperature had reached 105° was one in which the exacerbation of temperature, as has been noted, was due to an intestinal complication.

It is further observable that more than 50 per cent. of recovering cases have had a primary temperature of from practically normal to subnormal, and in a comparatively small number it exceeded 100°; and that in fatal cases, while the primary temperature in the majority was still normal, a higher degree was proportionately much more frequently encountered later than in those destined to a favorable issue. It is evident therefore that a low primary temperature gives no assurance of the result; but that an elevation above 100° is to be regarded as unfavorable as it approaches the limit of 102°.

The dependence of temperature upon the nature, extent, and complication of intracranial lesions as deduced from an earlier examination of a moiety of these cases has been confirmed by the further examination of their whole number. Hemorrhage in itself does not elevate temperature; it reduces it as it reduces the force of the circulation and depresses all vital functions; meningeal contusion increases it, and cerebral contusion increases it to a still greater extent. If these lesions existed singly diagnosis might be predicated upon temperature alone, but they are always multiple and the effect of one is more or less modified or counteracted by that of another; and as the case progresses new conditions may be introduced as arachnoid inflammation, septic infection, or it may be a simple asthenia.

Temperature, therefore, must be studied in the light of other symptoms; and as a diagnostic sign in ordinary cases it will be found to be most important very early in the case, though it may be highly characteristic of secondary accidents, such as a large subcortical hemorrhage breaking down the brain substance; or the supervention of a meningeal inflammation. It is the coincidence of at least some slight degree of meningeal or cerebral contusion which in a case of epidural hemorrhage occasions after reaction some rise of temperature; and it is the necessary co-existence of meningeal contusion with pial hemorrhage and of cerebral laceration with cortical hemorrhage which in these cases causes its still higher elevation.

The primary or earliest observable temperature has been found to be subnormal in a large percentage of cases, and practically normal in an almost equal number, and in neither case to be indicative of temperature to follow or of the final result. It may be merely one of the indications of a general shock in which an intracranial hemorrhage may or may not play a part. If such a hemorrhage exist as an influential factor, and reaction occur, temperature as already stated in the absence of intracranial contusion would rise to the normal degree and no higher; but with contusion it will continue to rise to some indefinite extent.

The rise may be progressive, or with recessions as circulatory and nutritive conditions vary, and in theory should always measure the extent of these altered conditions; that in fact it does not always do so is because these changes are not always the same in character. There is a possible exception to the rule, that some degree of contusion always accompanies intracranial hemorrhage, when with fracture of the vertex epidural hemorrhage is derived wholly from diplöic vessels.

This collection of cases cannot be said to confirm the theory of an existence of specific heat centres. If high temperatures have often been coincident with limited lesions which have involved regions described as specifically thermogenetic, they have equally characterized cases dependent upon lesions of every other part of the brain. The most extreme elevations and rapid progressions of temperature have been noted when with no localized injury there have been evidences of a profound general contusion. The extent and severity of intracranial injury rather than its limitation to any defined areas would seem in the light of clinical observation to determine excessive thermogenesis whatever its proximate cause.

It is not unsupposable that the primary subnormal temperatures may depend upon the abeyance of nutritive processes in the cerebral and meningeal cells in the first shock of injury, and that the subsequent excessive elevations may depend upon abnormally rapid destructive changes which follow the circulatory derangement.

The progressive rise of temperature which in so large a proportion of cases continues for thirty minutes or more after death, and sometimes to a remarkable extent, as a mere continuation of processes originating ante mortem requires no independent explanation. It is not observed after death from other forms of injury, but has an analogue in cases of Asiatic cholera.

ILLUSTRATIVE CASES.

Continued Subnormal Temperature.—See Case XXXIV.—*Consciousness.*

Case XXXVII.—*Subnormal, Rising to Normal Temperature.*

Recovery.—The patient fell ten feet to a ship's deck; consciousness lost for twenty minutes; both pupils dilated. On admission to the hospital: stupor; temperature 97.6°; right radial pulse 92, and the left 100 in the minute; hemorrhage from the right ear and nostril; right pupil dilated.

Temperature and pulse became normal in three hours, and there were no further symptoms except frontal headache; no memory at any time of having been injured.

CASE XXXVIII.—*Subnormal, Rising to High Supranormal Temperature. Necropsy.*—An unknown man was seen to fall in the street and was taken by way of a police station to the hospital.

On admission: patient in profound coma; temperature 92°; pulse, 48 and weak; respirations, 40, shallow and almost imperceptible; small contusion over right parietal eminence and another over left mastoid process; no extracranial hemorrhages: left pupil much dilated, the right contracted, both immovable; right patellar reflex exaggerated; the left normal.

Five hours later: temperature 101.8°; pulse 80, slow and irregular; respiration 38, occasionally Cheyne-Stokes.

Second day: patient still unconscious; temperature 103.2°–103.6°; pulse 80; respiration 30; left pupil normal in size but still immovable.

Third day: pupils symmetrical, contracted, and without reaction; right external strabismus; face cyanotic; temperature 101.4°–104.6°; pulse 80–100; respirations 38–48.

Fourth day: cyanosis continued; temperature 103.2°–103.4°.

Fifth day: temperature 104°–106°; respirations 54–56; death; consciousness at no time regained.

Lesions.—Fracture extended from a point corresponding to external contusion, and internally from a point in groove for left lateral sinus at junction of sigmoid, across groove for superior petrosal sinus to left superior occipital fossa near median line; fracture linear; posterior wall of lateral sinus torn for three-fourths of an inch and still gripped in the closed fissure; blood extravasated from sinus formed a thick clot over whole left hemisphere anterior to occipital lobe and filled left posterior and middle basal fossæ; no cerebral laceration; excessive hyperæmia and œdema of whole brain including cerebellum.

CASE XXXIX.—*Normal, Rising to High Supranormal Tem-*

perature. Necropsy.—Ambulance history: coma; complete left hemiplegia; right pupil dilated and immovable, the left normal: hemorrhage from right ear.

On admission to hospital: symptoms unchanged; no superficial injury; temperature 98.8°; pulse 92; respirations 20. Later: loss of vesical control; temperature rising to 101.4°; momentary return to consciousness after twelve hours.

Second day: symptoms not materially changed; patient very restless; both pupils markedly dilated; temperature 103°–105.4°–104°–106°; pulse 144–120; respiration 45–50–20; one violent epileptiform convulsion.

Third day: extreme restlessness and widely dilated pupils; temperature 107°–109.4°. Death.

Lesions.—Linear fracture through right squamous portion, and along anterior surface of petrous portion of temporal bone to sella turcica; contusion of anterior surface of petrous portion; epidural hemorrhage from laceration of trunk of right arteria meningea media, with clot compressing whole lateral aspect of cerebrum, and escape of blood through squamous fissure into temporal muscle; laceration of left temporal lobe with moderate cortical hemorrhage in middle fossa; excessive œdema of entire brain including cerebellum, basal ganglia, and medulla; moderate serous effusion in left lateral ventricle and in subarachnoid space.

CASE XL.—*Primary and Continued Supranormal Temperature. Necropsy.*—A man was found unconscious a few hours after his return to his apartment, and was sent to the hospital.

On admission: fully unconscious; temperature 102.4°; pulse 92; respiration 36; no external injuries except some œdema behind the right ear, some small blood clots in nares and right external auditory meatus; pupils widely and symmetricallly dilated, and without reaction; superficial and deep reflexes absent: responded to painful sensations; lack of rectal control.

He survived seven days without regaining consciousness, except that he once or twice opened his eyes when disturbed, and continued to respond to painful sensations, as when a hypodermic needle was inserted. Rectal control was not restored; urine from the beginning was voided at regular intervals apparently without volition or consciousness; the pupils became normal in size and reaction on the fourth day; muscular spasticity which had been noted on admission continued in upper extremities, but disap-

peared in the lower on the second day; fluid nourishment was retained; temperature varied from 102° to 101.6° on the second and third days; from 102° to 101° on the fourth day; from 101° to 103° on the fifth day, and from 103° on sixth day to 107° at death on the seventh day; and was 109° post mortem; pulse varied from 74 to 100 and was 112 at the last; respiration was usually normal in frequency but was occasionally accelerated.

Incision failed to discover fracture. On the third or fourth day operation was suggested by other surgeons who saw the case, but the suggestion was not accepted in view of the early and later temperature conditions, although the existence of intra-cranial hemorrhage was recognized.

Lesions.—Fractures: one extending from right parieto-occipital region through middle fossa to foramen lacerum anterius, and a second extending from one optic foramen to the other through the sphenoid body; epidural clot filling right middle fossa and extending upward upon the cerebrum; numerous lacerations of left frontal and temporal convolutions and central gyrus, right frontal and parietal lobes, and both gyri fornicati; disintegration of superior surface of right optic thalamus; areas of limited contusion in various parts of both hemispheres; intense hyperæmia of entire brain and meninges.

CASE XLI.—*Moderate Temperatures not Measuring the Amount of Severe Cerebral Contusion. Necropsy.*—A woman, 60 years of age, fell down stairs and was at once sent to the hospital.

On admission: patient could be aroused to answer questions; irritable; temperature 99.6°; pulse 86; respiration 28; hæmatoma in left posterior parietal region; pupils normal; incomplete left facial paralysis, and slight twitching of both hands.

Second and third days: condition unchanged.

Fourth to ninth days: generally in stupor and unable to recognize her friends or surroundings; rational at times; very irritable when aroused; temperature varied from 99.2° to 100°; once rose to 101°; pulse 68 to 136; respirations 20 to 34.

Lesions.—Meninges hyperæmic; extensive subcortical laceration of right cerebrum from angular gyrus to descending cornu of lateral ventricle: several smaller lacerations nearer the base; brain œdematous; bloody serum in both lateral ventricles, and choroid plexus markedly œdematous; small hemorrhage upon

floor of fourth ventricle; laceration in middle of right optic thalamus, and another in anterior part of right internal capsule; two small hemorrhages in left frontal lobe, and another larger just above anterior prefrontal space.

The relations of consciousness and temperature to the nature of the lesion as deduced from this series of cases and as apprehended by the writer have been more than once formulated, and are here restated:

The loss of consciousness,[16] which immediately succeeds a cephalic injury, is always the result of diffuse cerebral contusion; if unconsciousness is preceded by a conscious interval, however brief, or if after restoration of consciousness its privation soon recurs, it is occasioned by some form of intracranial hemorrhage. If, however, primary unconsciousness is permanent or greatly prolonged, its continuance may be due either to the severity of cerebral lesion or to a complicating hemorrhage; and whether the one has persisted from the beginning or been at any time replaced by the other, or whether both exist together, can be determined, if at all, only by a study of all the symptoms presented. The pulse, temperature, and respiration must be systematically recorded in every case from the first opportunity afforded for observation until the end . . . of these; the temperature in its course and variations will afford in the greater number of cases the most distinctive indication of the nature of the lesion . . . If, then, after the lapse of hours consciousness still remains in abeyance, a stationary temperature of but one or two degrees above the normal standard will indicate a hemorrhage of some profusion without serious cerebral injury; but a higher elevation which constantly increases, with possible recessions, will point to a visceral lesion. . . . The cases in which consciousness after brief restoration is again lost permanently, or for a lengthened period, have the same relations to temperature as those in which unconscious-

" Phelps—" The Question of Early Operation in Cases of Intracranial Injury." ANNALS OF SURGERY, December, 1877.

ness has been uninterrupted. It will be recalled that the recurrence of unconsciousness after an early interval of sensibility is indicative of an increase or supervention of hemorrhage, and that at a later period more or less conscious intervals in a general unconscious condition result from a lessening from time to time of the hyperæmia or œdema of a diffuse cerebral contusion. The question of hemorrhage should scarcely arise in the last instance, but the temperature still conforms to the general rule.

III.—PULSE.—The examination of the pulse in 745 cases in which pulse and temperature had been systematically recorded afforded some results of importance. The classification of pulse rate and temperature here adopted is necessarily arbitrary, but may be considered as essentially correct.

Temperatures:
  Subnormal, 98° and below.
  Normal, 98° + to 99° inclusive.
  Supranormal, 90° +.

Pulse rates:
  Subnormal, below 70.
  Normal, 70 to 80 inclusive.
  Supranormal, above 80.

The following tables are constructed in view of pulse and temperature relations.

Primary Subnormal Pulse:	Fatal Cases	Recoveries
With subnormal temperature	36	30
With normal temperature	16	10
With supranormal temperature	32	33

Primary Normal Pulse:		
With subnormal temperature	36	54
With normal temperature	21	41
With supranormal temperature	20	47

Primary Supranormal Pulse:		
With subnormal temperature	33	60
With normal temperature	36	53
With supranormal temperature	86	101

The inferences which these figures justify are not essentially important, allowance being made for the greater number

of recovering cases examined. Different combinations of pulse and temperature afford various percentages of subsequent deaths and recoveries; but the variations are not sufficient to form a basis for prognosis. Since these groups of cases necessarily merge along their lines of contact, a further comparison was made of cases as far removed from these lines as possible.

Subnormal Temperatures—97° to 92°.
  Fatal Cases:
    Pulse subnormal—Rate 68 to 46................ 15
    Pulse normal—Rate 70 to 78.................... 5
    Pulse supranormal—Rate 100 to 144........... 5

  Recoveries:
    Pulse subnormal——Rate 56 to 66.............. 5
    Pulse normal—Rate 70 to 78.................... 6
    Pulse supranormal—Rate 100 to 144........... 14

Normal Temperatures—98.4° to 98.6°.
  Fatal Cases:
    Pulse subnormal—Rate 60 to 64................ 2
    Pulse normal—Rate 70 to 80.................... 9
    Pulse supranormal—Rate 84 to 110........... 4

  Recoveries:
    Pulse subnormal—Rate 60...................... 1
    Pulse normal—Rate 76 to 80................... 7
    Pulse supranormal—Rate 88 to 98.............. 7

Supranormal Temperature—104.4° to 101.6°.
  Fatal Cases:
    Pulse subnormal—Rate 52 to 68................ 8
    Pulse normal—Rate 0........................... 0
    Pulse supranormal—Rate 84 to 140......... 17

  Recoveries:
    Pulse subnormal—Rate 60 to 64............ 3
    Pulse normal—Rate 70 to 80................ 4
    Pulse supranormal—Rate 84 to 120.............. 18

In all cases in which primary temperature was 102°, or above that point, the pulse rate was supranormal, at least 100 and usually much higher, except in certain cases of

alcoholism, and in two others—one with embarrassed respiration and cyanosis and one which is inexplicable and will be included in the series of illustrative cases.

·It does not appear from this later and more representative table that any practically important deductions affecting prognosis can be made from observations of the primary pulse. Generalizations are still found to be based upon differences in percentage too small to be of value. An exception to this general statement is in the fact that when temperature is not above 97° and pulse not above 66 death results in 75 per cent. of cases.

The primary pulse has some relation to the nature of the lesion. In cases of general contusion with or without laceration, but without hemorrhage of importance, it was normal, subnormal, or but slightly accelerated. If general contusion was accompanied by a considerable hemorrhage, usually pial or cortical, a supranormal pulse of 100 or more was so frequently encountered as to afford a fair presumption of such a complication of lesions. If the essential lesion was a hemorrhage it was usually epidural, and a subnormal or practically unaccelerated pulse was noted in 75 per cent. of cases.

Secondary Pulse.—In the progress of the case a discrepancy in the pulse rate and temperature elevation often become so marked as to be distinctive. This may occur at any period before the final stage when a decided acceleration of the pulse and elevation of temperature are usually coincident.

In the histories of 132 of the fatalities and of 201 of the recoveries in the second series of 500 cases, the records of pulse and temperature were sufficiently preserved to illustrate this abnormal relation. In 35 of the fatalities and 72 of the recoveries, 26 per cent. and 35 per cent. respectively, the pulse rate was normal or subnormal when the secondary temperature was above 100°; and in about one-half of these it decreased progressively as the temperature rose from the primary or immediately previous observation. Additional cases in which equally high temperatures are associated with a pulse rate

somewhat above but approximately normal, as from 80 to 90 in the minute, materially increase the percentage of nonconformities of pulse to temperature and confirm an impression derived from superficial clinical observation. Such characteristic want of correspondence between pulse and temperature is not observed in the course of any other form of injury or disease.

There are still other cases in which though the temperature, pulse and respiration are in harmony and practically normal, they are all at variance with related conditions. The patient suffering from the shock of serious injury may be supposed to have a subnormal temperature, feeble rapid pulse, and shallow or sighing respiration; but it sometimes happens that with a cerebral lesion, and with a cold, moist surface, and other recognized symptoms of shock, there is no disturbance of either temperature, circulation, or respiration, or at most some diminished tension of a pulse of normal frequency. In more frequent instances, though the essential element of surgical shock or collapse is an impairment of the vasomotor system and circulatory failure, the pulse remains of normal or nearly normal character while the temperature falls. Whatever may be the explanation there certainly is in some cases a difference in the indications of shock or collapse as it results from intracranial, or from other traumatism. The presence of some phenomena of the more general depression and the absence of others, serve to specialize the primary effects of these particular lesions—perhaps by reason of special ganglionic centres involved.

A single case may be quoted in illustration of what might be termed cerebral shock, and incidentally of a pulse peculiarity to be mentioned a little later.

CASE XLII.—*General Shock with Normal Pulse, Temperature and Respiration. Recovery.*—A lad 8 years of age was crushed between a wagon and a fence, receiving no injuries except of the head. On immediate admission to the hospital he was in stupor, but could be aroused and then complained of nausea and

vertigo. The skin was cold, pale and moist, the temperature 98.4°, the pulse 70, and the respiration 24. There was right facial paralysis, free hemorrhage from the right ear, contraction of the right pupil, and greater fulness and force of the right radial pulse than of the left. The external injuries were a wound in the left parietal, and a contusion of the right frontal region. During the first hour he vomited repeatedly. On the morning of the second day the pupils were both contracted, and in the evening they were both dilated, and he was delirious. His highest subsequent temperature was 101°.

At the end of the third week he had no symptoms remaining except some facial paralysis and dilatation of the pupils.

The want of conformity of pulse to temperature will be observed in many of the cases to follow. It will be found to be very marked in Case XXXVIII. The force and fulness of the pulse in general are not characteristic, and are as variable in intracranial as in other traumatisms.

Asymmetry of Opposite Radial Pulsations.—There is another pulse condition which is peculiar to this class of injuries. This is usually a want of correspondence in the force and fulness of arterial pulsation upon opposite sides of the body, and usually noted at the wrists. The increased tension is often wanting, and in rather exceptional cases the pulse rate differs while force and fulness may or may not remain the same. The frequency with which these aberrations occur is at the present time impossible to say; but the frequency with which they are noted seems to depend upon the care with which symptomatology is studied. It is probable that they can be discovered in a large minority, if not in the majority of cases in which opportunity is afforded for early and frequent observation. The summary of this subject made for the earlier collection of cases (Phelps, " Injuries of the Brain," p. 122 *et seq.*) requires little modification for the present larger number, and is reproduced with only slight modifications.

The want of symmetry in opposite radial pulsations was first recognized in the prosecution of that work in May, 1893, and since then has been found to exist in a considerable pro-

portion of the cases in which it has been sought. It is most frequently a primary aberration, but may not occur until the second day or even later. It is sometimes transient, disappearing in a few hours, sometimes intermittent but oftener continuous for some days if the patient survive. The bilateral variation usually attaches to strength and fulness of the pulse, or to its fulness alone, while in other respects the pulse is symmetrical with its fellow. In some instances the fulness and strength of pulsation upon one side are in startling contrast to its weakness and tenuity upon the opposite; in others the difference is slight, and to avoid the possibility of error if doubt existed was excluded from the record. The original characteristics of each radial pulse are ordinarily retained so long as a difference exists, but such are occasionally interchanged.

The stronger and fuller pulse has been found on the right side rather more frequently than on the left. It was observed on the first day in about 75 per cent. of cases, and while its later recognition may have been due in some instances to earlier neglect, in others primary symmetry was positively known from careful observation.

It has occurred in both fatal and recovering cases, but much more frequently in the former, 70 per cent. or more, and in the latter has almost always been in those of a serious character. The pulse has been usually of good force at both wrists, though exceptionally it has been weakened, and on one side even imperceptible. In one instance, perhaps anomalous, the left radial pulse was full and strong and the hand warm, while the right pulse was feeble and the hand cold. In a single instance, also exceptional, the smaller pulse had the greater tension. The opposite pulse rates only occasionally differed and then not to exceed eight or ten pulsations to the minute. This discrepancy occurred both as an independent phenomenon, and associated with the other asymmetric conditions.

The necropsies have disclosed all forms of hemorrhage—epidural, pial and cortical—variously situated; lacerations of

all lobes and of basal ganglia; and always with some degree of
contusion which was sometimes the essential lesion. There
were hemorrhages without laceration, and contusion without
hemorrhage. The inferential lesions, those indicated by symp-
toms but not demonstratable later by direct inspection, were no
less diversified. When limited lesions were discovered, the
fuller and stronger pulse had been on the opposite rather than
on the same side in a proportion of nearly two to one. There
were limited lesions on both sides of the brain, or only a gen-
eral lesion in a fair proportion of cases.

It is impossible, therefore, to infer the character or loca-
tion of lesions from this sympton; it is equally so from any
correlation which may exist between it and other symptoms
by which it is accompanied. A fact important in another con-
nection is that it is almost if not quite always associated with
an abnormality of the pupils or a loss of vesical control.

ILLUSTRATIVE CASES.

CASE XLIII.—*Primary Asymmetrical Pulsations. Necropsy.*
—A man fell fifteen feet and then walked across town to the hos-
pital. After admission he had a chill which lasted nearly two
hours, and was practically unconscious until death five hours later.
The right pupil was widely dilated and without reaction and the
orbital region was markedly ecchymotic. Pulsations of the left
radial and brachial arteries were strong and full, and were very
weak and small in the corresponding arteries of the right side.
Four hours after admission temperature had risen from 98° to
104.6°, pulse from 40 to 64; and respiration had fallen from 36
to 32. Temperature at death was 105° and thirty minutes post
mortem was 105.4°.

Lesions.—Fracture through right middle fossa involving the
temporal bone and the greater wing of the sphenoid, and lacer-
ating the anterior branch of the middle meningeal artery; firm
epidural clot occupying right middle fossa and extending over
temporal lobe; small laceration of opposite temporal lobe; small
extravasation into the pons; and small contusion in left Sylvian
fissure. The right temporal lobe was flattened laterally and
inferiorly, and when the epidural clot was removed the brain

retained its position widely separated from the middle fossa—including the outer half of the anterior surface of the petrous portion of the temporal bone. The small superficial cerebral vessels were distended, and the surface between them, at first pale, was soon reddened by a blush generally diffused. The surfaces of cerebral section soon became deeply reddened and bathed in watery effusion.

CASE XLIV.—*Primary Asymmetrical Radial Pulsation. Death.*—A child 2 years old fell two stories. The temperature on admission to the hospital was 100°; pulse 126; respiration 36. The right pulse was small, rapid, and irregular, the left only faintly perceptible; the pupils were dilated and the patient was unconscious. There was marked tonic contraction of the flexors of the fingers and extensors of the forearm, and later general convulsions which continued until death in the evening of the same day.

Incision made soon after admission disclosed extensive comminuted fracture of both parietal, both temporal and right occipital bones, and laceration of left posterior parietal lobe.

CASE XLV.—*Alternating Asymmetrical Radial Pulsation. Recovery.*—A man who had been found unconscious at the foot of a flight of stairs was admitted to the hospital with temperature 96.4°, pulse 66, and the right radial pulsations much fuller than the left. The respiration was irregular, sighing and chiefly abdominal; the left pupil was dilated and without reaction, the right contracted and responsive; the muscular system was completely relaxed; the urine was retained and the clothing stained with fæces. Hemorrhage from the right ear was constant and profuse, and there was blood in both nostrils. Some consciousness was soon regained and pupils became contracted and both responsive. The right radial pulse remained fuller and stronger than the left till the fourth day when the left became the fuller and stronger; and on the fifth day it was again the right, and on the sixth day radial pulsations were symmetrical. On the ninth day the radial pulse was once more the fuller and stronger, and on the tenth day pulsations were again symmetrical. The right radial pulse continued the stronger from the eleventh day, but on the twenty-third it differed but slightly from the left, and afterwards no difference was perceptible and all general symptoms ceased. The progress of the case was otherwise interesting. The

temperature rose on the second day to 102°, and there was a discharge of sanguinolent fluid and of disintegrated brain matter from the left ear, which on the third day was a simple oozing. The patient on the second day was exceedingly voluble and afterwards had occasional delusions of locality. Dilatation of the left pupil was persistent and was accompanied at times by left internal strabismus. The temperature became normal three hours after admission, then at once rose to 101.8°, and continued at high degrees, often above 103°, till the thirteenth day and afterward was below 100°. The pulse rate was usually normal after the second day but occasionally rose to 100 and once fell to 44. The respiration was usually from 20 to 24 but at times subnormal.

CASE XLVI.—*Secondary Asymmetrical Radial Pulsation. Recovery.*—A man who had been struck by a trolley car was admitted to the hospital still unconscious: Temperature 99.4°, pulse 70, respiration 18; pupils symmetrically dilated and without reaction; internal strabismus; radial pulsations symmetrical; reflexes normal.

Fifteen minutes later the pupils contracted, and the strabismus disappeared. Twelve hours later urine was retained. On the second day he was conscious and rational and vesical control was restored. On the third day the left radial pulse was fuller and stronger than the right; and on the fourth day radial pulsations were again symmetrical. No further symptoms.

CASE XLVII.—*Secondary Asymmetrical Radial Pulsation. Necropsy.*—The patient, whose manner of injury was unknown, was found in the street, conscious, slightly delirious, and with hemorrhage from the nares. On immediate admission to the hospital his general condition was unchanged and his temperature was 102°; his pulse 68, and his respiration 20. On the second day his pupils were contracted, his right pulse was weaker than the left, and his temperature rose to 105°. On the fourth day rectal and vesical control was lost and he was stupid and drowsy. He survived until the sixteenth day and consciousness was retained till the last twelve hours. His mental condition was variable; usually stupid, drowsy, irrational, restless, and at times delirious. Rectal and vesical control were not regained; the pupils were dilated and at times widely so; temperature usually high, varied from normal to 104°, and at the end was 105.4°. The asymmetry of the radial pulsations continued, and as late as

the thirteenth day the greater fulness and force of the left pulse was noted.

Lesions.—Fracture confined to the right orbital plate; no hemorrhages; no lacerations; intense hyperæmia and moderate œdema of the brain substance.

CASE XLVIII.—*Secondary Asymmetrical Radial Pulsation Including Frequency. Recovery.*—A man who had been struck with a bar of iron was at once admitted to the hospital, conscious, irrational and alcoholic. Temperature 99°; pulse 88; respiration 20. There was a lacerated wound over the parietal eminence and no other symptoms. On the second, fifth and seventh days the right radial pulse was fuller and more compressible than the left. On the third day the left pulse was 76 and the right 72, and on the sixth day respectively 84 and 79 in frequency. Left facial paralysis was manifest on the second day, and still existed in very slight degree when discharged from the hospital. The pupils were normal and rectal and vesical control was retained. Temperature rose to 103° on the fourth day with normal pulse and respiration, and to 102.4° on the eighth day with pulse and respiration still normal. On the twelfth day temperature was 98.6°, and there were no symptoms.

Case XXXVII affords an example of unequal pulse rates with pulsations otherwise symmetrical.

CASE XLIX.—*Discrepancy in Local Temperatures and Asymmetrical Radial Pulsation. Recovery.*—A man fell eight or nine steps down a stairway. On admission to the hospital he was in coma with a profuse hemorrhage from the left ear which continued two hours. The pupils were unequally dilated; the right radial pulse was feeble, and right hand cold; the left pulse was full and strong, and the left hand warm; and there was no apparent external injury. Consciousness returned gradually and was complete in six hours; the mental condition was then normal. There were no subsequent symptoms except severe left frontal pain and a sense of fulness in the head. At the first observation made five hours after admission, the temperature was 103°, the pulse 96, and the respiration 36. Later in the same day the temperature was 100°–103°, pulse 96–138, respiration still 38. Afterward the temperature was 99° and pulse had no noticeable peculiarity.

No definite relation was found to exist between intracranial tension and the general arterial pressure which might remain normal or be either increased or diminished, or might vary in the progress of an individual case. The cases selected for examination as to this relationship were such as well indicated the increase of intracranial tension by some of its characteristic symptoms, as loss of consciousness, high temperature with infrequent pulse, pupillary disturbances, and lack of rectal and vesical control. Arterial pressure was increased in a small minority of cases, markedly lessened in a much greater number, and normal or slightly lessened in the great majority.

IV.—RESPIRATION.—The respiration in ordinary cases is not characteristic. In general, it is oftener than otherwise moderately accelerated in the beginning, and in fatal cases, as with other injuries and disease, becomes very frequent towards the end. In recovering cases which are not greatly prolonged there is not usually a notable acceleration; and whatever the issue is to be, even with primary general shock, it is often primarily normal. Peculiarities of rhythm occasionally occur, and stertor, sometimes a symptom, is less frequent than usually supposed.

There is, however, a class of cases in which respiration is diagnostic. In these it may be shallow with cyanosis and pulmonary œdema; or it may suddenly cease, or be progressively retarded until there are not more than one or two respiratory acts in the minute. In either event there is subdural hemorrhage, pial or cortical, in one or both posterior basal fossæ. Indirect pressure exerted through the dura mater by an epidural hemorrhage does not produce the same result. The phenomena in the first instance seem to be due to direct pressure upon the intracranial portion of the pneumogastric nerve. It is of course assumed in diagnosis that cases are to be excluded in which with cardiac failure bronchial râles are formed *in articulo mortis*. In the second instance pressure is made upon the respiratory ganglia either by a limited clot or by the mass of fluid blood extravasated. These pressure conditions may occur separately or together, and cyanosis

may be the result of retarded respiration without the direct pulmonary lesion. In one case noted there was no hemorrhage into the fossæ and the pressure upon the medulla was made by a clot formed from blood·derived from the ventricles.

There is reason to believe that a clot sometimes begins to form upon the medulla and is later washed away by continued hemorrhage. This may serve to explain instances of very slow primary respiration which soon becomes and remains normal or frequent. Special reference was made to such a case in a previous consideration of this subject.[17] The respiration was five in the minute on first examination and subsequently ranged from thirty-six to forty-six till death. Small coagula found upon the medulla were thought to be probable " traces of a larger hemorrhage which primarily encroached upon its lateral aspect and at that time retarded respiration."

Compression of the medulla was noted in 34 cases, in 23 of which the nature of the lesion was made manifest in postmortem examination. In five instances, all of gunshot wound, death occurred at once or in the ambulance without opportunity for observation of symptoms if any existed, but in each the identity of the fatal lesion was unmistakable. In 24 of the remaining 29 cases respiration was progressively diminished in frequency and in the 5 others its cessation was sudden. In all cases primary temperature was below or but slightly above normal: in nearly all, consciousness was lost on admission; and in more than one-half, respiration primarily was abnormally infrequent. The interference with respiration usually occurred, if at all, very soon after the injury was received, but was sometimes deferred for several hours, and in one instance until the sixth day. Death followed in from a few moments to a few hours, and as in asphyxia generally the cardiac pulsations continued for an appreciable time after respiration had ceased. Other subarachnoid effusions, inflammatory or simply œdematous, did not check the respiratory movements.

In the 23 cases subjected to post-mortem examination the

" Lib cit. p. 101.

usual complication of lesions existed, but the hemorrhage into
the occipital fossæ was always present; and in a large propor-
tion of cases a clot rested upon the medulla, and often with no
other considerable hemorrhage. If the clot was absent the
basal hemorrhage was large. The clot often extended over
the pons, but when confined to that part, as was to be expected,
it did not affect respiration.

This peculiar respiratory default can hardly fail of recog-
nition, and it can rarely be anticipated; but the fact that a
serious intracranial hemorrhage has occurred may be obvious,
and with it an abnormally infrequent respiration is to be re-
garded as suspicious. A lesser number of respirations than
fourteen in the minute occurs in a few instances, and in nearly
all of these it is the precursor of a fatal result, and probably
indicates a medullary compression. On the other hand in
nearly 50 per cent. of such compressions primary respiration
was normal or abnormally frequent; so that while a primary
infrequency of respiration may have some prognostic signifi-
cance, its absence can have none.

While apnœa from direct compression of the respiratory
ganglia may have no great prognostic or therapeutic value it
is a definite symptom and result of intracranial injury and an
integral part of its history, and as such still has a special
interest and importance.

Peculiarities of respiratory rhythm, of which the Cheyne-
Stokes is an example, are not confined to this class of injuries
and when they exist are attributable to cerebral lesion.

ILLUSTRATIVE CASES.

CASE L.—*Progressive Retardation of Respiration. Necropsy.*
—Ambulance history: coma; extreme shock; wound over left
eye; right pupil contracted, the left dilated, and both immovable;
no hemorrhages.

On admission to the hospital: patient unconscious; pupils as
before; surface pale and cold; face slightly cyanosed; marked
subconjunctival hemorrhage in both eyes; slight right exophthal-
mos; reflexes absent; lack of vesical control; hæmatemesis; tem-

perature 98.2°, receded to 98°, and post mortem was 98.6°; pulse 69–120–90; respiration on admission, 14; in one hour, 12; in two and one-half hours, 9; in three hours, 5; in three and one-fourth hours, 3; two minutes later unchanged; three to ten minutes later still, 2; and *in articulo mortis,* ten minutes afterward, 1 ; cyanosis then extreme.

Lesions. —Fracture extending from floor of left middle fossa through both anterior basal fossæ, comminuting left orbital plate: thick epidural clot compressing laterally left frontal and temporal lobes; rupture of left middle meningeal artery at its bifurcation; pial hemorrhage in right posterior basal fossa with clot extending over pons and medulla; general hyperæmia and marked cerebral œdema; limited contusion of orbital convolutions.

CASE LI.—*Progressive Retardation of Respiration. Necropsy.*—Pistol-shot wound through right temporal fossa; permanent unconsciousness; unsymmetrical dilatation of pupils; left corneal reflex absent; urine retained; some pulmonary œdema; temperature 96.4° to 96° for five hours and later declined to 95.6°; pulse 85, 94, 80; respiration on admission to hospital, 14; for one and one-half hours, 12; in two and one-half hours, 10; in three hours, 8; in four and one-half hours, 6; in five hours, 4; and a few minutes later *in articulo mortis,* 2. Cardiac action said to have continued for three minutes.

Lesions.—Bullet severed right middle meningeal artery, passed through third right temporal convolution, and was lodged in the posterior part of the inner border of the right temporal lobe; small piece of bone driven in advance of the bullet found between the right lateral columns of the medulla; large mixed epidural and cortical clot filled middle fossa, spread over whole right hemisphere, and thickly covered pons and medulla; hyperæmia of right hemisphere including basic ganglia of considerable intensity.

CASE LII.—*Abrupt Cessation of Respiration. Necropsy.*—Patient fell fifteen feet and struck his head upon the pavement. On immediate admission to the hospital: unconscious; hemorrhages from nose and mouth; orbital ecchymoses; slight laceration of left ear from which blood had trickled deep into external auditory meatus; right pupil contracted and immovable; left pupil dilated and feebly reacting to light; vomiting at intervals; patellar reflexes absent; hemiplegia and anæsthesia complete on right, and incomplete on left side and of right face; left face

normal; temperature 99°; pulse 45; respiration 10. Twenty-two hours later temperature 101°; pulse 80; and respiration then normal ceased abruptly. Radial pulsations, 80 to 90 in the minute, and of good force, continued for an appreciable time afterwards.

Lesions.—No injury of scalp except some slight contusion of its deep surface in the left frontal region; left temporal muscle infiltrated with blood; fracture extending from a point in left parietal region directly above the ear across petrous portion and middle basal fossa into orbital plate which it comminuted; no epidural hemorrhage; thick cortical clot covering anterior part of left temporal lobe, from which a thin sheet of blood extended over whole left frontal and parietal lobes, anterior part of left occipital lobe, and first and second right parietal convolutions. Blood from left temporal region had also flowed through the Sylvan fissure, forming a clot which extended along the median line from a point anterior to the optic chiasm to the posterior border of the pons, and was a thick sheet over the left lateral half of that commissure. The hemorrhage was entirely derived from a single laceration which largely excavated the temporal lobe, and broke through the cortex at only a single point. The brain was moderately hyperæmic and œdematous.

The interpretation of the respiratory phenomena of this case is simple. The infrequent respiration on admission was due to primary cortical hemorrhage reaching the medulla, and the effect was transient because the pressure was relieved by the onward passage of the blood before coagulation. The final sudden cessation was the result of a renewed extension of hemorrhage over the medulla at the moment of death which again drained away into the occipital fossa.

CASE LIII.—*Late Respiratory Failure from Ventricular Hemorrhage. Necropsy.*—Patient fell down stairs and was at once admitted to hospital; no external injuries; coma; temperature 97.4°; pulse 60; respiration 16; hemorrhage from right ear, nose, and mouth; head and eyes turned to the left, pupils symmetrically dilated and without reaction, patellar reflexes exaggerated; muscles of both upper and lower extremities spastic, more marked on right side; loss of rectal and vesical control.

Later history: coma; muscular spasticity, loss of rectal and vesical control, and deviation of eyes to the left which continued

until death on the third day. The pupils became contracted but were still without reaction, and the right radial pulse was fuller and stronger than the left, on the second day; and the respiration was Cheyne-Stokes on the third day; temperature on the second day was 97.4° to 102°, and on the third day 101° to 103°. The respiration just before death rather suddenly fell to 5 to 4 in the minute.

Lesions.—Fracture extending from right occipital fossa through groove for lateral sinus, and petrous portion of temporal bone; complete excavation of left frontal lobe, and laceration of right occipital lobe. Cortical hemorrhage over left anterior parietal region; fluid blood filled lateral ventricles and escaping through fourth ventricle formed clot upon the medulla.

CASE LIV.—*Gunshot Wound of the Brain with Immediate Death. Lesions.*—Bullet of 0.32 calibre furrowed base of frontal lobe, passed obliquely inward and backward, perforated temporal lobe between first and second convolutions, and perforated dura mater, fractured squamous portion of temporal bone, and fell back into the cerebral cortex; no epidural hemorrhage; cortical hemorrhage confined to the basal furrow and to anterior surface of pons and medulla.

(To be continued.)

SKIN GRAFTING AT THE JOHNS HOPKINS HOSPITAL.

BY JOHN STAIGE DAVIS, M.D.,

OF BALTIMORE, MD.,

Assistant Surgeon in the Out-patient Department of the Johns Hopkins Hospital.

THIS paper is based on a review of 544 house cases which have been skin-grafted in the clinic of Dr. Halsted at the Johns Hopkins Hospital. In this series all types of grafts have been used, and skin defects on almost every part of the body have been grafted.

Technic for Thiersch Grafting: Preparation of the Skin from which the Graft is to be Cut.—Shave the selected area and scrub carefully with green soap and water, and rinse with water. Sponge with ether, followed by 70 per cent. alcohol; then with Harrington's solution (bichloride of mercury, 9 gr.; hydrochloric acid, 60 c.c.; water, 330 c.c.; alcohol, 600 c.c.) and finally wash thoroughly with bichloride of mercury solution 1 : 1000. Again wash carefully with sterile normal salt solution, and apply a sterile gauze dressing, wet with normal salt solution until ready to cut the graft. (When Harrington's solution is omitted use 95 per cent. alcohol and continue as above.) The grafts are almost always cut from the thigh, and usually from the right one when practicable. The anterior and inner portion is the first choice, the external aspect next, and finally, if necessary, the posterior portion. Occasionally the skin from the arm or leg is used.

Cutting the Graft.—Place a small sand-bag beneath the thigh in order to give a better surface from which to cut. Arrange the usual sterile dressings about the selected area. Care must be taken that no carbolic or bichloride solutions be brought into the field or touch the grafts, either on the dressings, gloves, or instruments.

The Catlin knife and the boards after being boiled are

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placed in salt solution, and the sterile rubber protective is removed from the bichloride solution, and also put in salt solution.

The skin wet with salt solution is then put on the stretch, and held as flat as possible by means of two sterile boards about 8 inches long, placed quite close together at right angles to the length of the limb, the first being held by the assistant, and the other by the left hand of the operator.

The edge of the sharp Catlin knife is then engaged in the skin between these boards and held almost flat against the limb (Fig. 1), and by a rapid sawing motion the graft is cut, the knife closely following the board in the hand of the operator, which is drawn slowly along in front of it (Fig. 2). The graft is cut at a level which will include the tops of the papillary layer of the corium, and only a slight amount of bleeding will follow.

After cutting the graft, it is picked up upon a piece of rubber protective, the raw surface being exposed. The whole is then placed upon a board and by means of a smooth instrument the graft is spread out evenly (Fig. 3). It is then covered with gauze wet in salt solution until the area to be grafted is ready. For several years the large grafts on the defects following operation on breast cases have been buttonholed here and there to get rid of air bubbles.

Application of the Graft.—Being sure that all bleeding has ceased, the protective on which the graft is spread is placed over the defect so that the graft is next to the wound. Then gradually the protective is lifted up and the graft is separated and left in place. It is pressed down evenly on the wound with pieces of gauze in order to get rid of any air bubbles, and to make it adhere as closely as possible. Should more than one graft be needed, they are placed so that they slightly overlap the edges of the wound and of the adjacent grafts.

Preparation of the Surface to be Grafted.—If the graft is to be applied to a clean fresh wound it is important to see that all hemorrhage has ceased, and that the wound is as dry as possible. If a granulating wound is to be grafted, it is

only necessary that the granulations be in a perfectly healthy condition before the grafting is attempted.

In a few cases the grafts have been applied directly to the healthy granulating surface after cleansing this surface as thoroughly as possible with irrigations, gauze pledgets, and wet compresses, being careful not to cause any bleeding. Lauenstein's method of rubbing off the granulations with sterile gauze tampons has also been used, but usually the granulations were thoroughly removed with a curette or scalpel down to the firm base, and the grafts applied. In addition to the above the unhealthy skin edges were excised and gridiron incisions made through the hard fibrous base of the ulcer to healthy tissue beneath, extending out into the normal surrounding skin, in order to obtain a better blood supply. In some old chronic ulcers the entire ulcer, including edges and base, was excised down to healthy tissue and the graft then applied.

Dressing of the Grafted Surface.—Since April 10, 1895, when sterile silver foil was first applied in this hospital as a dressing to the grafts, it has been used almost exclusively, and with excellent results. It is put on in several layers and over the last layer are placed the porous sheets of paper which come between the silver leaves. This dressing allows the secretions to come through and be absorbed by the gauze which is placed above it. The dressing is secured by a bandage and the part immobilized. The first dressing takes place ten days later.

Dressing of the Area from which the Graft is Cut.—All sorts of dressings have been tried, but the one finally adopted as the most satisfactory and comfortable is sterile boric acid ointment spread on sterile rubber protective. This dressing extends some distance beyond the margins of the wound and is held in place by strips of adhesive plaster, and over this is put a dry sterile gauze dressing and a bandage.

By the method above described the largest and most satisfactory grafts can be cut, but this requires a skilful hand and constant practice.

In the following statistics I have used this classification:

FIG. 1.

FIG. 2.

The boards in place, close together, holding the skin flat and on the stretch, with the Catlin almost flat against the thigh.

The graft being lifted up as the cutting proceeds, and the knife following close to the board in the left hand of the operator, the other board remaining in its original position.

FIG. 3.

The graft being spread out, raw surface uppermost, on a board, to be covered by rubber protective.

autodermic, where the graft is obtained from the same individual; *isodermic,* where the graft is obtained from another individual of the same species; *zoödermic,* where the graft is obtained from a lower species.

In the cases reported here, the large majority have been those in which it seemed best to use thin grafts, this being especially called for in covering the defect in the skin left by a complete breast operation. Most of the grafts were obtained by the modified Thiersch method as described above; a few by Reverdin's epidermic method; and one or two by Lusk's blister method. Comparatively few thick grafts have been used, only 21 cases in all, 12 being whole-thickness sessile flaps, and 9 whole thickness pedunculated living flaps, from a distant part. Sliding plastic flaps from the adjacent skin were used when possible, and the defect immediately covered with a Thiersch graft. A number of cases have been grafted in the out-patient department whose records I have been unable to obtain.

The ulcers following breast operations were allowed to heal by granulation until July 6, 1896, when one was grafted for the first time by Dr. Bloodgood. On October 5 of the same year a partial immediate graft was tried at the time of the operation, also by Dr. Bloodgood; and since that time practically every defect following a breast operation in which the skin edges could not be approximated has been grafted with a complete immediate graft.

The graft was spread on protective first on March 7, 1896, which procedure greatly facilitates placing it in position. The attempt is always made to cover the defect with a single graft, consequently very large single grafts have been cut. The notes on the measurements of both defects and grafts to be covered are very incomplete, but the following taken after cutting may be mentioned: 8 x 10 cm., 8 x 12 cm., 8 x 16 cm., 10 x 18 cm., 12 x 12 cm., 16 x 16 cm., and 15 x 16 x 14 cm. (irregular shape). Results show that these larger grafts take as well as the smaller ones. Size of defect to be covered: 8 x 10 cm., 10 x 10 cm., 10 x 12 cm., 11 x 11 cm., 12 x 12 cm., 12 x 14 cm., 14 x 14 cm., 15 x 15 cm., 20 x 20 cm., and 19 x 21 cm.

Thin Thiersch grafts of uniform thickness take better than those of varying thickness. Large grafts cannot be cut from a fat or flabby thigh.

Several recontractions have taken place under Thiersch grafts, especially those placed on the palm of the hand, and there seems to be no doubt but that a whole-thickness graft in this and other exposed locations would be more satisfactory.

Several cases of phlebitis of the long saphenous vein followed cutting grafts from the left thigh; and for this reason the right thigh is used whenever practicable, no case of phlebitis having yet followed cutting on this side.

In quite a number of cases black Thiersch grafts have been placed on white patients, and white grafts on black patients, with fair results. The pigment disappears or appears after a comparatively short time in Thiersch grafts, but there is no case in our series which will show the effect of the pigmentation of a whole-thickness graft thus transplanted.

When more skin than was required was cut, in several cases it was grafted on the wound from which it came with complete take.

What seems to be a failure at the first dressing will sometimes turn out very well, and *vice versa*. Some grafts are moist and there is considerable secretion throughout the healing process, while others are perfectly dry. In the moist variety a strong characteristic glue-like odor is often noticed. This moisture is probably due to secretions which are held back by the silver foil and paper, which becomes saturated soon after the operation, and then dries and forms an impermeable dressing, preventing the further escape of the secretions and also the ingress of air. Any one who has dressed grafted wounds covered with silver foil and paper will have noticed this fact in many cases, while in others the secretions do pass through and leave the wound dry. This latter is especially noticeable in those instances where alcohol is not used to moisten the paper in order to make it adhere more closely. In fact if the paper is used at all on these cases, which is unnecessary, it should not be moistened with

the alcohol, both for the reason mentioned above, and also because the alcohol is injurious if it should soak through to the graft. It is best therefore to omit the paper and alcohol and to place dry gauze immediately next to the foil.

Too much pressure of the dressing on the grafted area may cause sloughing of the freshly applied graft, and a heavy dressing, causing too much heat and sweating, is to be avoided. In the majority of cases the wound caused by the cutting of the graft is healed some time before the patient is ready to leave the hospital.

In this series I have counted as a single case all the grafting done on any one patient during that particular hospital admission. For instance, if the patient is grafted two different times, or has two defects grafted at the same time, both being complete takes, then this is called one complete take.

Should one graft completely take and the other partially take, then this would go under complete and partial takes, etc.

GENERAL SUMMARY.—Taking a general summary of the cases grafted we find that there were 286 breast cases, 88 leg ulcer cases, 85 miscellaneous ulcer cases, 76 contraction cases, and 9 defects following excision of keloids, etc., making a total of 544 cases, of which 383 were females and 161 males. The average age of the complete takes was 42 years, the youngest being 3 years and the oldest 79 years.

Variety of Grafts.—497 autodermic Thiersch, 13 isodermic Thiersch, 10 autodermic and isodermic Thiersch, 11 autodermic whole-thickness sessile flaps, 6 autodermic whole-thickness living flaps from distant parts, 3 autodermic Thiersch and living flaps from distant part, 1 autodermic Thiersch and whole-thickness sessile flap, 1 autodermic Reverdin and isodermic Thiersch, 1 autodermic Thiersch and Reverdin and isodermic Thiersch, 1 zoödermic, from dog. Altogether there were 40 cases in which isodermic Thiersch grafts were applied: 19 were complete takes, 16 were partial takes, and 5 were failures, thus showing that isodermic grafts are on the whole well worth trying. Nineteen thick grafts from distant parts

were used: 10 whole-thickness sessile flaps, with 9 complete takes and 1 partial take; and 9 living flaps, with complete take of all of these.

Dressings.—Silver foil, 442; 52 gauze, wet with normal salt solution, covered by rubber protective; 21 rubber protective and dry gauze; 2 gauze, wet with bichloride; 1 olive oil and protective; 1 collodion and protective; 25 not stated.

Result of Grafting.—Complete takes, 341; 168 partial takes; 14 complete and partial takes; 1 partial take and failure; 3 complete, partial take, and failure; 17 failures.

Condition when Discharged from the Hospital.—Healed, 412; 115, with granulating wounds, for the most part small; 13, no discharge note; 4, died.

Using the 69 partial-take breast cases as the base number, we find that the average length of time in the hospital after operation, of breast cases with complete take of immediate skin graft, is about 20 days; of partial-take immediate graft is about 28 days; and where no graft was used about 35 days. The 69 complete takes were all discharged healed. Of the partial takes, 22 cases were healed, 44 cases had small granulating wounds, in 3 cases the result was not stated. Where there was no graft the great majority were discharged with a fairly large granulating area. These figures show that grafting such cases, even if not completely successful, hastened considerably the healing process.

Conclusions.—The general health of the patient must be taken into consideration when skin grafting is contemplated, and grafts to be successful must only be transplanted to healthy wounds. As a rule grafts do not take well on luetic individuals. No antiseptics must touch the flaps before or after cutting. A general anæsthetic is necessary in the majority of cases where large grafts are removed. It is best to cover the defect with a single large graft if possible, as the healing is just as satisfactory as if several small flaps were used, and the scar is much less. Silver foil immediately over the graft has proved its worth, but it is best to apply it without the paper and not to use alcohol. Temporary moist salt gauze dressings are also very satisfactory.

Grafting, even if only partially successful, in the majority of cases will shorten the time in the hospital and accelerate final healing. Partial grafting nearly always stimulates epidermal growth from the edges of the wound.

Autodermic grafts take somewhat better than isodermic, but isodermic grafts are much more successful than is generally supposed. When a black superficial graft is applied to a defect on a white person the pigment disappears sooner or later, and *vice versa*. The majority of Thiersch grafts, especially on breast cases, that I have examined were still adherent throughout the greater part of their extent. The shrinkage in the size of a wound after grafting is in some cases quite remarkable.

Contraction is prevented to a large extent by grafting, although it sometimes occurs, especially under Thiersch grafts on exposed positions, such as the palm of the hand. In such locations the whole thickness of the skin should be transplanted. Slough of the axillary flap in breast cases has little effect on the healing of the grafts, as in many of the complete takes there was slough of the flap, and in many of the partial takes there was no slough. Mild wound infection, such as pyocyaneus, seem to have little effect on the ultimate healing of the graft.

CYST OF THE ROUND LIGAMENT OF THE LIVER.

BY M. S. HENDERSON, M.B.,

OF ROCHESTER, MINNESOTA,

Surgical Assistant at St. Mary's Hospital.

AFTER a somewhat superficial search through the literature for data on the subject, the following report of a case is thought worthy of recording on account of its apparent rarity. Comparatively speaking, numerous references have been found of cysts of the round ligaments of the uterus but none of cysts of the round ligaments of the liver. This case is the only one of the kind that has been met with in the Mayo Clinic at St. Mary's Hospital.

E. A. M., male, aged 41, presented himself for examination January 13, 1909. His complaint was the presence of an abdominal tumor. The following history was given.

One morning, about eight years before, on attempting to straighten up after stooping to lace his shoes, he was seized with a violent cramp in the region of the umbilicus. He was unable to stand erect on account of the excruciating pain, and had considerable difficulty in getting to his bed. The pain gradually lessened, and after a good bowel movement, the result of an enema, he was free from discomfort. There was no nausea and no vomiting during the attack. This attack was the only one of the kind that he had; but his business affairs were exacting and his general health began to fail. Symptoms at this time were indefinite; he was treated for neurasthenia, and soon after, while being examined by his physician, an abdominal tumor about the size of a lemon was discovered, the exact nature of which was doubtful. Laparotomy was advised, but deferred. Under treatment for his nervous condition he improved, was able to resume his business, and as the tumor gave him no discomfort the operation was put off from year to year. The tumor gradually increased in size, however, until at the time of our examination it was about the size of a head.

Cyst of the round ligament of the liver

Physical examination showed a rather thin, dark complexioned man. Heart and lungs negative, as were also the blood and urinary findings. On palpation of the abdomen a freely movable fluctuating tumor was to be felt. When left to assume the natural position, it was seen to be just to the right of the umbilicus and a little below it. It was not tender, there was no tympany over it, and it did not move with respiration. The movement downward was more limited than the upward and lateral movements, as it could be easily placed in either flank or be pushed up beneath the liver. A positive diagnosis could not be made, but an exploration was advised and accepted.

Operation, February 12, 1909, by Dr. W. J. Mayo: A median incision below the umbilicus was made, and upon opening the peritoneal cavity a straw-colored thin-walled cystic tumor about the size of a child's head presented immediately beneath the abdominal wall. The tumor was anterior to the omentum which was found tucked up behind it. Putting in the hand to explore for the site of the attachment, it was found to be intimately associated with the abdominal wall, just above the umbilicus. The incision was accordingly elongated to two inches above the latter, by which means the cyst could be partially delivered outside the abdomen. Gauze dissection was used in freeing it from its pedicle, causing very little hemorrhage, as there were no vessels of any size running to it. It was then seen that the cyst had its origin in the lower two inches of the round ligament of the liver, where the latter is closely attached to the abdominal wall. The cyst was removed without rupture. A photograph was taken which is shown herewith (Fig. 1).

The patient's recovery was uneventful. He left the hospital on the twelfth day, and for his home in three weeks from the time of operation.

HOUR-GLASS STOMACH.*

BY WILLIAM A. DOWNES, M.D.,

OF NEW YORK,

Associate Attending Surgeon to the New York Hospital; Assistant Surgeon to the General Memorial and St. Francis Hospitals; Instructor in Surgery Cornell University Medical College.

ALTHOUGH twenty years have elapsed since Bardeleben reported the first operation for the relief of hour-glass stomach, and nearly 200 operated cases have been recorded in the literature during this time, the obscurity often attached to the diagnosis, the difficulties to be overcome in the presence of marked adhesions and distorted anatomical relations and the final solution of the problem by applying the correct operative procedure, afford sufficient reason for calling the attention of this society to a single case which, in part at least, was of my own making.

N. T. Female, aged 33, was admitted to the General Memorial Hospital in the service of Dr. Wm. B. Coley (to whom I am indebted for the privilege of operating upon and reporting the case) December 11, 1906, with a typical history of acute perforating gastric ulcer. Operation seven hours after perforation. The opening, an unusually large one, was situated on the anterior surface of the stomach, midway between the lesser and greater curvatures, about five inches from the pylorus. It was surrounded by a thickened indurated area, one and one-half inches in diameter. The size of the opening (which would easily admit the tip of the index finger), the induration and the favorable location, made this seem an ideal case for excision, and, accordingly, an elliptical area measuring about three by two inches was removed. The incision was closed with chromic gut in the usual way, transversely to the long axis of the stomach. The suture line extended up to but did not encroach upon the lesser curvature. The abdominal cavity was not flushed, but a small pocket containing mucous and gastric contents situated between

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coils of intestine and omentum just to the left of the median line was swabbed out and a cigarette drain introduced through the lower angle of the wound. Drainage removed on fifth day. Wound healed without suppuration. The patient made a good recovery and at the time of her discharge from the hospital. January 17, 1907, had gained eleven pounds in weight. She soon resumed her work (that of a housemaid) and continued in excellent health, weighing, in July, 1908, 149 pounds.

During the September following, that is three months less than two years after the operation, she began to suffer from " gas in the bowels " which was accompanied by a dull pain coming on about two hours after eating and extending from the left hypochondrium down to the umbilicus. Eating meat caused exaggeration of the pain and was usually followed by vomiting. These symptoms became progressively worse, and her decline was as rapid as had been her gain following operation. She was re-admitted to the hospital October 8, weighing 130 pounds. Lavage, dieting, and rest in bed, afforded slight relief to the symptoms, but did not check the loss in weight which had fallen during the subsequent three weeks to 117 pounds. Dr. Harold Barclay examined the stomach on four occasions during these three weeks with the following results:

Upon distention an unusually large cardiac portion could be readily mapped out, but the pyloric portion could not be distended. This was attributed to adhesions binding down this part of the stomach which in turn gave rise to the symptoms. On each of these occasions she had been given on the evening before a meal composed of a meat sandwich and from fifteen to twenty raisins. The washing at the first examination brought back 50 c.c. of stomach contents, consisting of meat and raisins. The washing at the second, as well as at the fourth examination, brought up nothing; at the third washing 120 c.c. were obtained. Hydrochloric acid present; no lactic acid. No blood in washings at any time. No tenderness in epigastrium. The possibility of hour-glass stomach was strongly considered. but " adhesions binding down the pylorus, with pyloric spasm " was thought to be the most likely diagnosis.

Operation, November 12, 1908. Gastrogastrostomy. Median incision from ensiform to the umbilicus. The greater omentum had been caught up on the abdominal wall at the site of the old

scar, and had to be cut across before the stomach could be exposed. Then a tumor could be felt involving the stomach and liver, which at first was thought to be cancer; but after completely exposing the stomach this mass was found to be composed of dense adhesions binding the anterior wall and lesser curvature to the under surface of the left lobe of the liver. A typical hourglass stomach with a cardiac pouch about twice the size of the pyloric pouch, was disclosed (Fig. 1). The channel connecting the pouches would just admit the tip of the index finger plus the invaginated stomach wall. The cardiac pouch extended well up under the ribs and its wall was markedly thickened, while that of the pyloric portion was normal in appearance; the pylorus was not stenosed. The adhesion between the stomach and liver was so extensive and so completely organized, that it was out of the question to separate these structures; for this reason and the fact that the pouches could easily be approximated—in the presence of a patent pylorus—gastrogastrostomy was decided upon as the operation best suited to the case. This was easily accomplished with the aid of stomach clamps, and a three-inch vertical incision was so placed that the pouches communicated freely at their lowest points (Fig. 2). Convalescence rapid and uneventful. Discharged December 2, 1908, and returned to work four weeks later. At this writing, four months after operation, she weighs 146 pounds—a gain of 29 pounds—and can eat food of any kind without distress.

I feel that it is hardly necessary to venture the opinion that had posterior gastro-enterostomy been added to the original operation—and the patient could easily have stood it, the conditions requiring the second operation would not have arisen. As to the factors entering into the cause of the complication under discussion, not the least was the cigarette drain which had been so placed that it prevented proper descent of the omentum, with the result that this structure adhered to the abdominal wall throughout the lower half of the incision. In turn, the normal excursion of the stomach was limited, thus inviting the formation of perigastric adhesions. The constriction, involving, as it did, almost the entire circumference of the stomach at the junction of the middle and distal

FIG. 1.
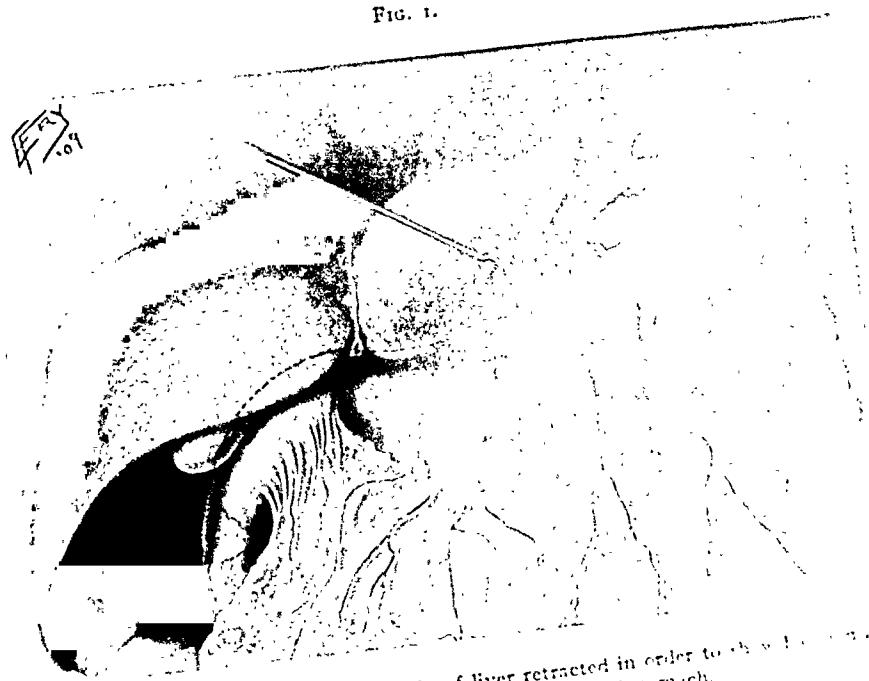
Hour-glass stomach.—Margin of left lobe of liver retracted in order to show the extent of the adhesion between liver and stomach.

FIG. 2.
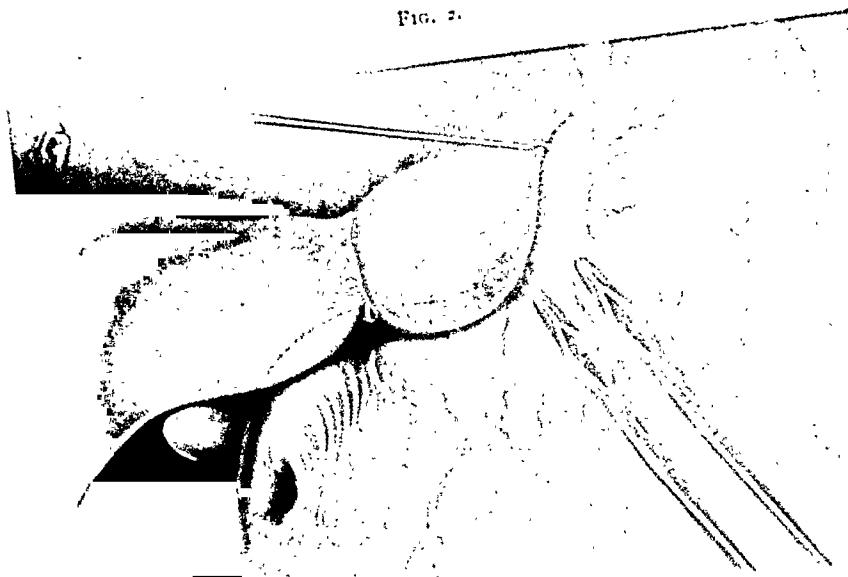
Gastro-gastrostomy.—Clamps in place. Oesophagus drawn up.

thirds, was composed largely of cicatricial tissue which was undoubtedly just as important an element in the formation of the stricture as was the liver adhesion. Whether other ulcers were present and were overlooked at the time the one which perforated was excised, or the cicatrix resulting at the site of excision accounts for this scar tissue, I am unable to say. We know, however, from the writings of men best fitted to pass judgment on the subject, that ulcers which extend transversely to the long axis of the stomach, in the process of healing do lead to hour-glass stomach—in fact this is the most frequent cause. If you recall, the suture line in this case ran in that direction, and knowing, as we do, that any wound of the stomach or the intestine tends to contract, especially if in its closure a proper apposition of the mucous membrane is not obtained, I am therefore inclined to believe that the cicatrix was a factor in the formation of the stricture and that the suture line was wrongly placed. In the future, if I have occasion to excise an ulcer of the anterior wall, I shall make the incision parallel with and not transverse to the long axis of the stomach—as is the custom—first applying stomach clamps to control hemorrhage. I shall also dispense with drainage after operation in this region, except in the presence of an abscess or fistula, and then will see that the drain is so placed that it will interfere with the omentum as little as possible.

As to the second operation I am not sure, upon reflection, but that gastro-enterostomy would have just as well met the immediate indication and, at the same time, have been a safeguard against the recurrence of ulcer.

Frequency.—That hour-glass stomach is not of infrequent occurrence, is shown in every large series of cases of ulcer of the stomach examined both at autopsy and on the operating table. Grünfeld of Copenhagen, quoted by Veyrassat,[1] found the stomach to be the seat of an old ulcer in 124 out of 1150 autopsies, in 38—or 30 per cent. of which hour-glass contraction was present, the stenosis being too tight to admit the tip of the index finger in 8 cases. Moynihan[2] in 1905 re-

ported 198 operative cases of chronic ulcer of the stomach, encountering hour-glass contraction 19 times, or in 9 per cent.

In 925 operations for ulcer of the stomach and duodenum, W. J. Mayo[3] says they have found hour-glass contraction 31 times, or in 3.3 per cent. of the cases. This is by far the largest single series of operations for ulcer yet recorded and probably represents very accurately the frequency of this complication in this country at least.

Etiology.—It was formerly thought that a considerable proportion, if not the majority of cases of hour-glass stomach, was of congenital origin. That this contention is incorrect, however, has been proven conclusively by the findings at operation. Ulcer, either active or healed, perigastric adhesions or cancer have been present in every case. Mayo Robson[4] states that in over 500 operations on the stomach he has not met with a single case of congenital hour-glass contraction. Only one undoubted case has been reported, according to Moynihan. Gardiner[5] has recently added a case to the literature, being that of a child three months old, in whom the condition was found at autopsy. As stated above, ulcer, adhesions or cancer have been so consistently present at operation that we are justified in attributing all cases to one or the other of these causes. Ulcer, as Veyrassat has well said, dominates the pathogenesis of hour-glass stomach. It may act by contraction of the stomach wall during cicatrization, or by setting up adhesions with the abdominal wall or adjoining structures, or finally by predisposing to the development of cancer. When biloculation results from cicatrization, the ulcer has usually originated either in the anterior or posterior wall or in the lesser curvature at or near the middle of the stomach and has extended transversely to its long diameter. As a rule, the puckering is at the expense of the greater curvature, but Moynihan refers to two cases in which the opposite condition was present.

Perigastric adhesions may form bands which constrict the stomach, or, more commonly, a given point on the stomach wall may become so fixed to the parietes, liver or pancreas.

that biloculation will necessarily take place. These adhesions result in the majority of cases from an ulcer which has either perforated or extended down to the serous coat and become adherent to the peritoneum of adjacent parts. They may also follow injury or disease of adjoining structures, or operation involving this region. In the case herewith reported the adhesion to the liver was the direct result of operation.

Cancer implanted upon ulcer, or from whatever cause arising, situated at the points already mentioned, may lead to hour-glass stomach; however, again quoting Veyrassat, "this complication is merely an episode in the progress of the gastric neoplasm and is of consequence only as it concerns the treatment of that disease."

The constriction may be located in any part of the stomach, but most often involves the pyloric half, and, as a result, the cardiac pouch is the larger in the majority of cases. The relative size of the pouches and the thickness of their walls depend in a measure upon the calibre of the opening connecting them. A long, narrow channel results in a much dilated cardiac pouch with hypertrophied walls. If there is stenosis at the pylorus, which is not uncommon, both pouches become dilated and their walls thickened.

Robson and Moynihan[6] report two cases of double constriction forming a trifid stomach. One followed cicatrization of an extensive ulcer; in the other, an adhesion to the liver subdivided the cardiac pouch. The duodenum may also be the seat of hour-glass contraction. In the 925 operations for ulcer of the stomach and duodenum (about equally divided as to location), reported by W. J. and C. H. Mayo, hour-glass contraction was encountered 31 times—once in the duodenum and 30 times in the stomach. The same etiological factors no doubt prevail when the duodenum is the seat of this deformity as when it is located in the stomach, to which an added factor of no little importance would be periduodenal adhesions following inflammation of the gall-bladder and passages.

Symptoms of hour-glass stomach differ very little, if any, from those due to narrowing of the pyloric orifice. They

follow, as a rule, in due time the preceding history of gastric ulcer. Taken alone the symptoms give no clue to the diagnosis, but if considered along with certain characteristic physical signs, will lead to a correct diagnosis in the majority of cases. Moynihan [7] says of his first 6 cases that only 1 was correctly diagnosed; but of the last 9, 7 were diagnosed with certainty. Naturally the signs of most value are those obtained from washing out the stomach and by distending it with gas. The following classification of the usual signs is practically that of Moynihan:

1. If a known quantity of water is introduced through the stomach tube and only a part is returned, the missing portion must have passed into a second cavity (Wölfler's first sign).

2. If the stomach is washed until the fluid returns clear and in a short time is again washed with the result that the fluid is returned dirty and perhaps foul smelling, it is evident that regurgitation has taken place from some connecting cavity (Wölfler's second sign).

3. After washing out the stomach and apparently completely emptying it, a splashing sound may be elicited, due to a portion of the fluid remaining in the pyloric pouch (paradoxical dilatation of Jaworski).

4. Upon passing in a quantity of fluid there may be distention of the cardiac pouch which gradually subsides to be followed by bulging in the pyloric region (Von Eiselsberg).

5. If the two halves of a seidlitz powder are given separately, and the stomach is auscultated, no loud forcible sounds are heard in the normal stomach except at the pylorus; if, however, constriction is present, the same sounds may also be distinguished to the left of the median line (Von Eiselsberg).

6. Moynihan first called attention in 1902 to a sign which has since been of great assistance to him in making the diagnosis of hour-glass stomach. The abdomen is carefully examined and the stomach resonance percussed. A seidlitz powder in two halves is then administered. On percussing after about 30 seconds an enormous increase in the resonance

of the upper part of the stomach can be found, while the lower part remains unaltered. If the pyloric pouch can be felt or seen to be clearly demarcated, the diagnosis is inevitable, for the increase in resonance must be in a distended cardiac segment. If the abdomen be watched for a few minutes the pyloric pouch may be seen to fill and become prominent.

7. On distending the stomach with CO_2 a distinct sulcus may be seen.

8. Radiography following the administration of bismuth mixture, gastrodiaphany and such measures may be of value in obscure cases, but are unlikely to be necessary.

The treatment of this condition is, of course, surgical, and the essential feature of any operative procedure as applied to a given case of hour-glass stomach, is that it shall provide complete drainage; failing in this the result will not prove satisfactory.

A careful examination of the stomach and its surroundings, with a full understanding of the cause and location of the constriction, is necessary in every instance, before a final decision is reached as to which method to employ.

The following operations have been resorted to in the treatment of hour-glass stomach, and when applied to suitable cases, either singly or in combination, will afford the desired relief: Gastroplasty; gastrogastrostomy or gastroanastomosis; gastro-enterostomy; partial gastrectomy (partial resection, annular mediogastric resection, pylorogastrectomy); dilatation. The dividing of adhesions has also been classed as an operation, and while it is apt to be a necessary adjunct to any procedure, may in a rare case of itself suffice.

Gastroplasty, an operation similar to pyloroplasty, was first used by Bardeleben in 1889. An incision, four or five inches in length, with its centre over the stricture, is made in the long axis of the stomach and is then closed in the opposite direction by two rows of sutures, the first including the entire wall and the second peritoneum and muscularis. Kammerer's[5] operation, a modification of the above, similar to Finney's operation for pyloric stenosis, is, according to Moynihan,

the better operation. The use of the stomach clamp in Kammerer's operation as recommended by Gould[9] in his modification of Finney's pyloroplasty, would be of distinct advantage. Gastroplasty is indicated, if at all, only in thin-walled movable stomachs. It is contra-indicated when marked induration and extensive adhesions are present, on account of the difficulty in approximating the pouches and in getting stitches to hold, in active ulceration because it does not put the stomach at rest, and in all cases where the pylorus is stenosed.

Gastrogastrostomy or gastro-anastomosis consists in forming a vertical opening between the two pouches, so arranged that free communication will be established at their lowest points. The use of the stomach clamp has greatly simplified the technic of this operation, and, like gastroplasty, it is easy of execution, but has distinct limitations. It is permissible only in those cases in which the pouches are relatively large and sufficiently dependent to permit of their being easily approximated. As in gastroplasty, the pylorus must be open and the stomach free from active ulceration.

Gastro-enterostomy (posterior) should be the operation of choice in hour-glass stomach, for it best fulfils the essential requirement—drainage. Besides, by giving the stomach rest, active ulcers heal, and the chance of a recurrence is minimized. The anastomosis should be formed with the cardiac pouch, and only in those cases with co-existing pyloric stenosis is anything further necessary. In these it may be combined with either gastroplasty or gastro-anastomosis, or the suggestion of Weir and Foote[10] to unite each pouch to the jejunum by separate openings, may be adopted. In a number of instances on account of failure of the surgeon to properly examine the stomach before proceeding with gastro-enterostomy, death has followed as the result of forming the anastomosis with the pyloric pouch—that is distal to the obstruction. It may be permissible in rare cases where the stricture is high up in the cardiac half of the stomach to form the anastomosis with the pyloric pouch after manually dilating the stricture. Blake[11] reports such a case in which the result was excellent.

Partial gastrectomy is a more formidable operation than the preceding and should be reserved for those malignant cases in which a radical operation is justified and for indurated ulcers of a doubtful nature.

Dilatation is not a procedure to be recommended and should only be resorted to when, on account of adhesions or location of the stricture, other methods are impossible.

RESULTS.

All the cases reported up to August, 1908, have been collected by Veyrassat, with the following result:

Gastroplasty: 48 cases—36, or 75 per cent., cures; 7, or 14.6 per cent., failures; 5, or 10.4 per cent., deaths.

Gastrogastrostomy: 22 cases—15, or 68 per cent., cures; 3, or 13.6 per cent., failures; 4, or 18 per cent., deaths.

Gastro-enterostomy: 73 cases—57, or 72 per cent., cures; 2, or 2.7 per cent., failures; 14, or 19.1 per cent., deaths.

Six of the 14 deaths following gastro-enterostomy resulted from an error in technic—the intestine being united to the pyloric pouch.

RADICAL METHODS.—(a). *Partial resection.* 3 cases—1 cure; 2 deaths.

(b). *Annular mediogastric resection:* 12 cases—11, or 91.7 per cent., cures; no failures; 1, or 8.3 per cent., deaths.

(c). *Pylorogastrectomy:* 2 cases—no deaths.

COMBINED OPERATIONS: 21 cases—4, or 19 per cent., deaths.

REFERENCES.

[1] Veyrassat: Revue de Chirurgie, Aug., Sept. and Dec., 1908.
[2] Moynihan: Abdominal Operations, W. B. Saunders, 1905. p. 664
[3] Mayo, W. J.: Personal Communication, March 1, 1909.
[4] Robson, Mayo: Keen's Surgery, W. B. Saunders, 1908. p. 877.
[5] Gardiner: Jour. Am. Med. Ass'n., Nov. 9, 1907, p. 1598.
[6] Mayo Robson and Moynihan: Surgical Treatment of Diseases of the Stomach, second edition.
[7] Moynihan: British Medical Jour., Feb. 20, 1904, p. 414.
[8] Kammerer: Annals of Surgery, 1903. vol. xxxvii, p. 281.
[9] Gould: Operations upon the Intestines and Stomach, W. B. Saunders, 1906, p. 229.
[10] Weir and Foote: Med. News, May 2, 1896, p. 483
[11] Blake: Annals of Surgery, 1903, vol. xxxvii, p. 280

DIAGNOSIS AND TREATMENT OF CARCINOMA OF THE CÆCUM.*

BY EUGENE A. SMITH, M.D.,

OF BUFFALO, N. Y.,

Adjunct Professor of Clinical Surgery in the University of Buffalo.

IN May, 1901, I published in *American Medicine* a report of a case of carcinoma of the cæcum, operated upon April 11, 1900. In condensed form the report was as follows:

CASE I.—The patient was a woman of 38 years who gave a history of dyspepsia and failing health dating back some months. She had lost 40 pounds in weight, and was suffering from colicky attacks, with constipation becoming more and more pronounced. Five weeks before presenting herself for operation she first noticed in the right side a tumor which gradually enlarged. Upon examination a movable nodular mass, roughly the size of a split orange, could be grasped between fingers and thumb and pushed to the umbilicus or up into the right hypochondriac region under the free border of the ribs. Usually it lay in the right lower quadrant of the abdomen and had previously been mistaken for an inflammatory mass due to appendicitis, or a floating kidney.

Through abdominal incision, three inches long, in the median line, the tumor was delivered and found to be a carcinoma at the ileocæcal junction, mainly involving and nearly filling the cæcum. The head of the cæcum was invaginated, resembling a glove-finger pulled into itself as the finger is withdrawn, almost concealing an unusually long appendix. The omentum and mesentery were free, excepting a few mesenteric nodes which were found enlarged and were dissected out.

Gauze strips were passed through the mesentery around the ileum, about 4 inches from the cæcum, and around the large gut at the junction of the cæcum and ascending colon, and the strips tightened to control the circulation and occlude the lumen of the intestine. The tumor-bearing portion of intestine was then cut bodily from the mesentery, all vessels being caught and tied separately. The cut ends were closed by a Murphy button anastomosis of the ileum and transverse colon, made through a longitudinal slit in the transverse colon about 5 inches from the closed end of the ascending colon. The anastomosis was reinforced with an additional row of interrupted silk sutures. The peritoneal cavity was cleansed by irrigating with normal salt solution, and the abdomen closed.

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* Read before the Pathological Society of Rochester, N. Y., December 8, 1908.

The patient was given half-pint normal salt solution enemas every six hours till flatus was passed. The bowels were moved on the fourth day, and thereafter food was given sparingly for a week. The button was passed on the sixteenth day, and three weeks after the operation the patient went home.

The tumor and nodes were examined by Dr. H. U. Williams, Professor of Pathology, University of Buffalo. He reported the neoplasm to be an adenocarcinoma of colloid type. The enlarged nodes were not the result of metastasis, but were inflammatory and no doubt due to septic absorption from the fungoid ulcerating surface of the tumor within the bowel lumen (see Fig. 1). The tumor itself is about the size of a lemon. · The specimen is in the Army College Museum.

April, 1909.—Since her recovery she has regained and has maintained her health and weight, and has borne two children in the nine years since the operation.

CASE II.—Mrs. C., mother of three children; menopause at 45. Was 56 years old in August, 1907. Family history good. Health good until December, 1906, when her appetite became poor and bowels constipated. In July, 1907, she began to lose weight and fell away gradually till I saw her September 25, 1907, losing in all 20 pounds. In the early summer she discovered a lump in the lower abdomen. The constipation became more marked and she often had colicky pain with rumbling of gas. The lump grew larger slowly.

On examining Mrs. C., I found her anæmic and emaciated. Her heart and kidneys were not affected. The abdomen was distended in the right lower quadrant and peristaltic waves in intestinal coils moving toward the cæcal region were plainly seen. A mass somewhat irregular in outline and about the size of an orange was plainly felt in the right inguinal region, and on pressure the patient complained of tenderness.

On September 30 I operated, incising in the outer edge of the right rectus and exposing a freely movable tumor of the cæcum which was delivered onto the abdominal wall through an incision 4 inches long. The colon at the junction of the cæcum and the ascending colon having been clamped, the cæcum was cut away. Now the ascending colon was occluded by purse-string and inversion of the cut end. The same procedure was next done on the ileum about 3 inches from the ileocæcal junction. I then freely cut into the mesocæcum and mesentery, removing a wide triangular flap and removing all lymph-nodes which were demonstrable. I next made a lateral anastomosis between the blocked ends of intestine an inch from the closed ends. No drain was used. The patient made a good recovery, disturbed only by a subcutaneous abscess and cellular infection of colon bacillus type. She is at present (July, 1909) in good health and has gained 18 pounds within 22 months after operation.

Dr. H. U. Williams examined the tumor and pronounced it an adenocarcinoma of colloid type, mesenteric nodes showing no metastasis. He has mounted it for the college museum (see Fig. 2). The tumor was about the size of an orange.

In both tumors, proliferation of the neoplasm is noted chiefly

within the lumen of the cæcum, nearly filling the cavity of the gut and distending it to make a mass nearly as large as an orange. A rod as large as a lead pencil found its way with difficulty through the tortuous channel still present in each ileocæcal valve and the lumen of the cæcum itself. The rod shows in each figure.

Cumston and Vanderveer collected 79 cases of cancer of the cæcum which they reported with 2 cases of their own, one being reported by each writer, in the ANNALS OF SURGERY for January and February, 1902. Of these operations 4 were exploratory openings of the abdomen. Excluding these exploratory operations, 33 of the remainder resulted fatally and 44 of the patients recovered—some with an artificial anus. The statistics of these operations in the years just preceding the publication were noticeably better than those of the earlier surgical periods.

Cumston and Vanderveer discuss entero-anastomosis after resection of the cæcum at length in their article, paying special attention to methods of enterorrhaphy to approximate the large open colonic end to the smaller open end of the ileum.

To me it seems wiser and easier to occlude the colonic end and make the lateral implantation of the ileum into the colon already described in Case I, or still better, to close both ends and make a lateral anastomosis between the blocked ends, as in Case II. A better circulation is insured by these methods for the anastomosis. Each cut edge of mesentery is free to recover its circulation, eliminating the so-called " dead space " at the mesenteric border which leads to leakage in end-to-end anastomosis. At the site of the anastomosis, a far better circulation is insured by either method. In the implantation only the cut end of bowel has had its mesenteric circulation impaired, and danger of leakage is lessened, while in a lateral anastomosis leakage occurs only as a fault in technic.

In cases of irremovable cancer of the cæcum, an ileosigmoidostomy or ileocolostomy is indicated to " short circuit " the diseased area, if bowel obstruction is imminent or present. If operation is done for patients suffering from obstruction of the bowel due to cancer of the cæcum when the patient's condition is such that a resection or a short circuiting by lateral anastomosis for irremovable cancer cannot be done at

Glass Rod

Caecum

Ileum

Appendix

Appendix

Ileum

Rod
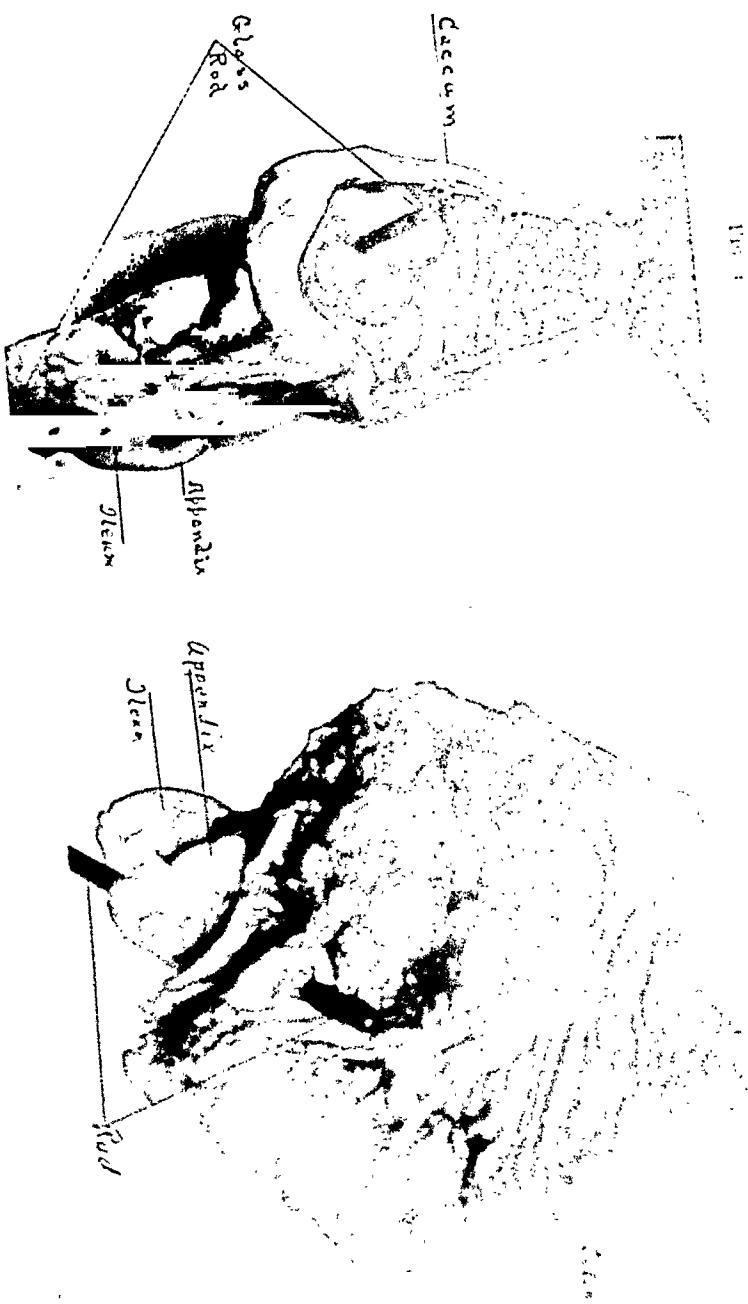
the time, an artificial anus can be made. This procedure should only be considered, however, as a matter of necessity and a future operation to short circuit the disease and close the artificial anus should be done, if possible.

In reporting their own cases, Cumston and Vanderveer own to a diagnosis of appendicitis in one of them and to an exploratory laparotomy in the second—diagnosis being uncertain. Cumston removed the appendix in his case, and eight weeks later again operated to attack the true disease that had made itself more manifest by symptoms of bowel obstruction and palpable tumor. Vanderveer made an exploratory laparotomy to make his diagnosis which was obscured by the abdominal distention of complete bowel obstruction.

In discussing symptomatology, I include with the two operated cases three cases of inoperable cancer of the cæcum which I saw in consultation when too far advanced to be removable and which were not in need of operation to relieve obstruction.

In all my cases pain of a colicky nature due to mechanical interference with peristalsis, and most severe in the lower right side of the abdomen, occurring on several occasions. had caused the attending physicians to diagnose chronic appendicitis. In the first case a floating kidney was later diagnosed, when the large movable tumor was found.

In all of the cases the characteristic group of symptoms were loss of appetite, impaired digestion, loss of flesh and color, occasional diarrhœa. and, later, constipation increasing in obstinacy, accompanied by colicky pains most severe in the right lower quadrant of the abdomen. The patients had a low-grade septicæmia, temperature occasionally reaching 99.5 or 100° F.; slow pulse early in the course of the disease, and faster as weakness became more pronounced; no chills or sweats; hæmoglobin low.

Indicanuria. when present. is an indication of obstruction of the bowel. when considered with the symptoms already given. In Case II Dr. Abbott made two examinations of the urine before operation.—one six months before and one a few days before operation. Both showed indican increased R^o-

peated examinations since operation show no increase of indican.

No blood examination was made in Case I, but in view of the ulcerating interior of the tumor mass and the inflammatory lymph-nodes, a moderate leucocytosis could be readily explained, although a secondary anæmia was to all clinical appearance the most likely blood condition. In Case II, just before operation, Dr. Abbott found hæmoglobin 65, red cells 3,500,000, and leucocytes 8500—no differential count being made.

In none of my cases could a history of bloody or mucous stools be obtained; but it must be remembered that careful observation of evacuations is rarely made by patients. Dr. Abbott reports no blood found in his examination of the stool in Case II just prior to operation.

These signs and symptoms can be grouped under two headings: those of a low-grade septicæmia plus the toxæmia of intestinal putrefaction, and, secondly, those of increasing mechanical interference with peristalsis—that is, obstruction of the bowel.

Upon the discovery of a tumor the signs and symptoms just considered take on new significance. We may be dealing with tuberculosis of the cæcum, impaction of fæces, floating kidney, tumor of the kidney, chronic appendicitis, distended gall-bladder. or ovarian tumor. Cumston and Vanderveer mention also gastrectasis, gastroptosis, and carcinoma of the stomach. The picture of cancer of the cæcum heretofore given may be clear enough to make a differential diagnosis easy in many cases. In some, exploratory incision may be necessary to determine the diagnosis.

The length of time elapsing before the tumor mass actually does become palpable bears strongly on prognosis. Careful physical examination is often overlooked by physicians, or the new growth would be discovered earlier, beyond doubt, than actually does occur in most cases. In scirrhus forms of cancer the tumor may be progressive for many months before it becomes palpable or visible; or it may not be found till exploratory operation is done, or after death. In colloid forms

it may appear much earlier,—within two months from the onset of symptoms, as in Case I, or within five or six months, as in Case II.

Cancer of the cæcum has come under my observation much less frequently than cancer of the sigmoid flexure or of the rectum. I have had 5 cases, of which 2 were operable and removable and are herein reported. My colleague, Clinton, has seen 3 cases, 2 advanced and inoperable and 1 which recovered after resection of the cæcum with end-to-end anastomosis of ascending colon and hypertrophied and distended ileum. The resection was done eight months ago, and the patient is at present in good health.

Sutton says carcinoma is more frequent in the lower than in the upper part of the intestines. In every 100 cases of intestinal cancer, according to him, 75 occur in the rectum, 23 in the large intestine and 2 in the small. Of the 23 cancers of the large intestine, 2 occur in the cæcum, 3 in the hepatic flexure, 4 in the splenic flexure, 10 in the sigmoid flexure, and 4 elsewhere in the colon.

If 2 per cent. of cancers of the intestine are cæcal in situation we must admit the need of considering this disease in all cases of chronic disease of the right lower quadrant of the abdomen. The earlier the diagnosis the more hopeful is the outlook after resection. My result in Case I is most encouraging, nine years of elapsed time being a most convincing proof of the complete removal and cure in this case of cancer of the cæcum.

All authorities agree that next to early diagnosis, surgical interference and wide and thorough operative removal is essential for a cure. Line of section should take an inch to two inches of healthy bowel with the growth if possible, and as wide a section of mesocæcum and mesentery as can be done without damage to the bowel circulation. Owing to the ulcerative process on the mucous surface of the growth, the lymphatic nodes are enlarged early in the disease from septic absorption rather than from metastasis of cancer, judging by my experience in two cases. Enlarged lymphatic nodes should be sought out and removed.

In the future I will choose for the operation in resecting the cæcum for removable carcinoma, inversion of both ends of the cut intestine followed by lateral anastomosis by the clamp method between the stumps, or between the stump of the ileum and the most accessible portion of the colon, preferably the ascending or transverse colon.

A review of the literature on this subject since the paper of Cumston and Vanderveer in January, 1902, in ANNALS OF SURGERY, was made for me by Albert Allemann, M.D., of the Medical Library of the Army Medical Museum, Washington, D.C. He adds 38 cases to the number which they report. I append to this paper a brief history of each case and the journal in which the report was made.

REPORTED CASES SINCE JANUARY, 1902.

SURMONT: Bull. Soc. centr. de med., Lille, 1902, 221. CASE I.—Male, 50 years of age. No previous history. Incision was made, but nothing done. Patient died six days afterward.

ANSCHUTZ, W.: Verhandl. d. deutsch. Gesellsch. f. Chir., Berlin, 1902, xxxi, pt. 2, 413. CASE II.—Male, 40 years of age. A few months before the first symptoms. Operation; death shortly after operation (sutures tear through). CASE III.—Male, 58 years of age. First symptoms a few months before. Operation: resection of cæcum. Death, twelve days after. CASE IV.—Male, 53 years of age. Two months before first symptom. Operation: removal of cæcum. Complete recovery. CASE V.—Male, 30 years of age. First symptom about a year before. Operation: removal of cæcum. Complete recovery.

LAMAS, A.: Revista médica de Uruguay, Montevideo, 1903, vi, 201. CASE VI.—Male, 30 years of age. Four months ago first symptom. Operation: nothing done, drainage; second opening: declared inoperable.

ATHERTON: Maritime Med. News, Halifax, 1903, xv, 174. CASE VII.—Male, 30 years of age. About year before began to have constipation. Operation: incision; more than a foot of bowel removed. Recovery.

BÉRARD: Lyon médical, 1903, c. 431. CASE VIII.—Woman, 30 years of age. First symptom five months previous. Operation: entero-anastomosis, on account of great weakness. Second operation: cæcum removed. Recovery.

BALLOCH, A.: Washington Med. Ann., 1903, ii, 12. CASE IX.—Male, 36 years of age. Cold. Three weeks before first, griping pains. Operation: cæcum removed with 3 inches of ileum. Good recovery.

REVERDIN, J. L. Rev. méd. de la Suisse romande, Genève, 1903, xxiii, 440. CASE X.—Male, 63 years of age. No previous history given. Removal of cæcum. Death on eleventh day.

CESTAN: Toulouse méd., 1903, 2 S., v, 272. CASE XI.—Woman, 52 years of age. Previous dyspepsia symptoms. Operation: "partial extirpation," cæcocolic entero-anastomosis. Recovery; "complete cure" was not intended.

DARLING, C. G., AND LOREE: Med. Record, N. Y., 1903, lxiii, 938. CASE XII.—Male, 46 years of age. First noticed swelling and pain eight weeks before. Operation: cæcum removed. Complete recovery.

NO AUTHOR.—St. Thomas's Hosp. Rep., 1903, Lond., 1904, xxxii, 190. CASE XIII.—Female, 58 years of age. Pain commenced three weeks ago. Operation: resection of 5 inches of ileum, cæcum and part of ascending colon. Patient never rallied; died on third day. St. Thomas's Hosp. Rep., 1903, Lond., 1904, xxxii, 190. CASE XIV.—Female, 65 years of age. Five months previous diarrhœa and pain. Operation: resection of cæcum and small part of ileum; artificial anus. Death on twentieth day.

FROHWEIN, F.: Ein Fall von primärem Cæcum-carcinom. Kiel dissertation, 8°, Kiel, 1903. CASE XV.—Male, 59 years of age. For a month past diarrhœa, etc. Diagnosis: inoperable carcinoma of cæcum. Operation for anus præternaturalis. Six days after patient died.

FRANÇOIS–DAINVILLE: Bull. soc. anat. de Par., 1904, lxix, 166. CASE XVI.—Male, 32 years of age. Three weeks before pain. Operation: ileocæcal resection. Recovery.

SLAUGHTER, R. M.: Virginia Med. Semimonth., Richmond, 1904-5, ix, 401. CASE XVII.—Male, 46 years of age. Suffered from acute appendicitis. Operation: resection of cæcum; recovery.

NEHRKORN AND KAPOSE: Beitr. z. klin. Chir., Tübing., 1904, xliii, suppl., 126. CASE XVIII.—Woman, 64 years of age. Six weeks previous symptom. Operation: patient is weak, therefore anastomosis between ileum and colon. Recovery. Radical operation was not advisable.

HUPPERT, P.: Ueber einen Fall von primarem Gallertcarcinom des Cæcums. München dissertation, 8°, München, 1904. CASE XIX.—Woman, 70 years of age. For thirteen weeks previous had to lie in bed on account of abdominal pains. Diagnosis: tumor of cæcum or omentum. No operation; death. Illinois Med. Journ., Springfield, 1905, viii, 3. CASE XX.—Female, 25 years of age. Pains about one and one-half years before. Operation: cæcum with part of ascending colon removed. Recovered completely.

PLUMMER: Illinois Med. Journ., Springfield, 1905, viii, 464. CASE XXI.—Female, 25 years of age. Pain four years, first symptom. Operation: removal of cæcum and part of ascending colon. Recovery complete.

CARLESS: Med. Press and Circular, Lond., 1905, lxxix, 649. CASE XXII.—Woman, 65 years of age. Symptoms noticed only a few weeks before. Operation: ileocolostomy. Patient's condition did not permit a radical operation. Good recovery.

WILSON, C.: Mobile Med. and Surg. Journ., 1905, vii, 277. CASE XXIII.—Male, 40 years of age. First symptom a few months ago. Operation: cæcum removed. Recovery complete.

DEPAGE: Journ. de chir. et Ann. soc. belge de chir., Bruxelles, 1905, v, 194. CASE XXIV.—Female, 66 years of age. Year ago intestinal

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obstruction. Operation: anastomosis between ileum and colon; patient was weak. About a month later another operation, but tumor was found inoperable.

GIAUNI, V., AND ROLANDO, S.: Gazzetta degli ospitale, Milano, 1906, xxvii, 1523. CASE XXV.—Male, 61 years of age. About a year previous had pain. Operation: cæcum with 5 inches of ileum removed. Died five hours after.

DEL CASTILLO: Revista ibero-american de ciencias med., Madrid, 1906, xvi, 169. CASE XXVI.—Male, no age given. No previous history. Was not diagnosed until too late; was not operated. Death.

GAYET: Lyon méd., 1906, cvii, 840. CASE XXVII.—Female, 54 years of age. Three months ago first symptom. Operation: a cæcostomy. Twenty days later cæcum removed with tumor. Recovery.

ABERG: Hygiea, Stockholm, 1906, vi, 256. CASE XXVIII.—Female, 56 years of age. About two years ago first symptom. Operation: resection of cæcum and part of colon. Recovery.

SHEARS: Clinic, Chicago, 1906, xxxvii, 719 (Homœopathic). CASE XXIX.—Female, 52 years of age. Two years ago first pain in abdomen. Operation: excision of cæcum and anterior part of ileum. Recovery.

JONES, O. M.: Montreal Med. Jour., 1907, xxxvi, 449. CASE XXX.— Woman, 52 years of age. Complained of pain twelve months previous to operation. Operation: excision of cæcum; Murphy button. Recovered; did well for a year, but died twenty-one months after operation of "cancer of the blood." Postmortem examination showed no return in intestine. CASE XXXI.—Male, 42 years of age. Attacks of vomiting for a year previous. A surgeon removed appendix, and fistula formed. About two years later patient consulted author. Operation: cæcum with portion of colon removed. Recovered completely. CASE XXXII.—Male, 27 years of age. Pains commenced eight months ago. Removal of cæcum with mass of involved omentum. Recovered completely. CASE XXXIII. —Male, 61 years of age. Pains for six months previous. Operation: removal of cæcum and portion of liver (cautery). Died one month after operation. CASE XXXIV.—Male, 42 years of age. Pain sixteen months previous. Operation: resection of cæcum with lateral implantation of ileum. Recovered completely.

BAUBY AND PUJOL: Toulouse méd., 1907, ix, 219. CASE XXXV.— Male, 65 years of age. About six months ago first symptoms. Resection of cæcum. Recovery.

ATHERTON, A. B.: Canada Lancet, Toronto, 1908, xlii, 104. CASE XXXVI.—Male, 30 years of age. For a year previous crampy pains, etc. Operation: about 18 inches of bowel removed. Recovered completely.

LEREBOULLET AND DIXIER: Bull. et mem. soc. méd. d. hôp. d Par., 1908, 3 S., xxv, 397. CASE XXXVII.—Male, 56 years of age. Thirteen months ago he began to lose flesh, and had pain in right abdomen. Not diagnosed. No operation. Patient died. Autopsy: cancer of cæcum.

GIRARD: Rev. méd. de la Suisse romande, Genève, 1908, xxviii, 257. CASE XXXVIII.—Male, 45 years of age. For a year past violent pains in abdomen. Diagnosis: possible tuberculosis or cancer of cæcum. Operation: cæcum excised; Murphy button; complete recovery.

RESECTION OF THE COLON FOR CANCER AND TUBERCULOSIS.*

BY JOHN H. GIBBON, M.D.,

OF PHILADELPHIA,

Professor of Surgery in Jefferson Medical College; Surgeon to the
Pennsylvania Hospital.

THE following ten cases which have occurred in the last
six years constitute my entire experience in resection and
anastomosis of the colon for cancer and tuberculosis. I
have excluded those cases of cancer of the upper rectum
in which the sigmoid has been anastomosed with the lower
rectum, as this operation is one of entirely different technic
from that required for growths above the rectum. I have
also excluded several resections of the small intestine up to
the ileocolic juncture with lateral anastomosis between the
ileum and the colon. I have eliminated a few cases where
I have anastomosed the small intestine with the sigmoid
for the purpose of side-tracking the colon. In other words,
the discussion will be limited entirely to pure resections and
anastomoses of the colon. Of these ten cases eight suffered
from carcinoma and two from tuberculosis:

CASE I.—H. D.; male: 55 years of age; Pennsylvania Hospital. Diagnosis: *Acute intestinal obstruction; carcinoma of
colon; thoracic aneurism and chronic endocarditis. Resection of
descending colon and immediate anastomosis, July 24, 1923.
Sudden death eight hours later.*

This man presented the appearance of having been a hard
drinker. His abdomen was markedly distended, with no particular rigidity, pain or tenderness. He was nauseated but had
not vomited. Bowels had not moved for five days, in spite of
laxatives and enemata. The transverse colon was very much
distended and could be easily made out. The abdomen was opened
in the median line by an incision extending above and below the

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umbilicus. When the peritoneum was opened a dark-colored fluid escaped. The colon was first examined. It was found normal throughout, excepting just above the sigmoid flexure, where a hard mass could easily be felt. When this was delivered it was found to be a carcinoma, producing absolute obstruction. The abdominal cavity was filled with a quantity of dark fluid containing flakes of lymph. The carcinomatous mass, together with a proper amount of bowel, was resected; two glands were removed from the mesocolon and an end-to-end anastomosis, by means of two rows of silk sutures, was performed. A rectal tube was introduced well above the point of anastomosis; two strips of gauze were placed about the seat of anastomosis and the bowel returned to the abdomen. The cavity was then thoroughly irrigated and closed. A large quantity of gas and liquid fæces escaped through the tube. The operation occupied more time than it should have done, because of the difficulty in bringing the diseased bowel out through the median incision. In another such case I would feel inclined to make a second incision in the left iliac region. The patient did well after operation for about eight hours, when he was suddenly taken ill with cardiac symptoms and died. At the autopsy a large aneurism of the thoracic aorta was discovered, and Dr. Longcope, pathologist of the Pennsylvania Hospital, thinks that the cardiac condition present was sufficient to account for the sudden death. There were evidences, however, as there were at the time of the operation, of peritonitis.

Comments: In this case I should have made a second incision, done a colostomy and postponed the resection until later, or performed a resection and drained the bowel and made the anastomosis later. A lateral anastomosis would have been better than the end-to-end one which I did. Under the circumstances the overlooking of the thoracic aneurism would seem justifiable.

Pathology: Adenocarcinoma of colon; serofibrinous peritonitis; congestion of lungs; general arterial sclerosis; diffuse aneurism of arch of aorta; chronic aortic and mitral endocarditis; left-sided cardiac hypertrophy and slight diffuse nephritis.

CASE II.—M. D.; female; 70 years of age; Pennsylvania Hospital. Diagnosis: *Acute intestinal obstruction; adenocarcinoma of colon. Resection and immediate anastomosis, January 7. 1905. Death twenty-third day after operation.*

I saw the patient first about nine o'clock on the day of operation, with Drs. Bennett and Musser; there was nothing in the previous history to throw any light on the cause of the obstruction. She had suffered from moderate constipation and had had some attacks of abdominal pain. She had always been very secretive about herself and it was difficult to get any satisfactory history. One noticeable point was that she had habitually restricted her diet to very simple things. She had not lost weight. For four days previous she had been unable to have a bowel movement and had become gradually more and more distended. The distention was more marked on the right side of the abdomen, but at no time was Dr. Bennett able to feel any mass. There had been no nausea or vomiting excepting once, when oil had been given. The temperature was normal; pulse about 80: the abdomen greatly distended, slightly more so on the right side than on the left. The patient complained of some pain on the left side which came on in paroxysms. Nothing could be felt by the rectum or by the vagina. Her general condition was very good, but it was evident that she was suffering from complete obstruction of the bowels, which in a short time would end fatally unless some radical relief was offered promptly. I thought that she was suffering from a volvulus or else from a growth in the cæcal region. A notable point in view of the findings at the operation is the fact that there was no history of ribbon stools or the passage of bloody mucus. Considerable time was lost in convincing the patient of the necessity for an operation, and especially of the necessity for her removal to a hospital. This was finally accomplished, and at about three o'clock I operated. As the right side of the abdomen was more distended than the left, I determined to open through the right rectus. The moment the peritoneum was divided there escaped a quantity of peculiar gelatinous material, light in color, resembling the contents of a colloid cyst. There also presented in the wound an enormously distended cæcum, dark in color, which looked like a cyst. I supposed that there had been a rupture of a malignant ovarian cyst. When the wound was enlarged, however, the cæcum was delivered. It was distended more than I had ever seen it. The appendix was also very much thickened but not distended, and attached to it was a quantity of the same gelatinous material which had escaped from the abdomen. The cæcum

was so distended that I realized that I would be able to do nothing
inside the abdomen until its size was reduced. When delivered,
a quantity of its contents rushed into the small intestine, rapidly
distending this portion of the bowel which had before been prac-
tically empty. I thought that in some way the opening from the
ileum into the cæcum had been obstructed. The cæcum was
punctured with a knife; a large quantity of gas rapidly escaped
and the bowel collapsed. The opening was then closed and I
made an exploration of the abdominal cavity. There was no
mass in the pelvis, the uterus being very small and the
ovaries atrophied. I noticed one or two small nodules over
the broad ligament, however. Examining the colon I found a
mass about the middle of the descending colon. This could not
be delivered through the wound on the right side and I therefore
opened the abdomen through the left semilunaris. Before I did
this, however, I was obliged to reopen the cæcum because it
could not be returned to the abdomen, as it had again become
distended with gas. Through the opening on the left side I
delivered the mass in the colon which seemed to be a carcino-
matous growth producing an annular contraction of the bowel.
With some difficulty, because of the shortness of the mesocolon,
I succeeded in resecting about ten or twelve inches of this bowel,
going about 8 inches above the growth and about 3 inches below
it. An end-to-end anastomosis was made by means of a large
Murphy button. A gauze drain was introduced down to the site
of anastomosis and the wound closed. Before closing the wound
on the right side I removed the appendix; and it presented the
appearance already described which I had never seen before.
The patient was on the operating table one hour and forty min-
utes. Her pulse at the end of the operation was 100 and her
condition remarkably good. I was prepared for considerable
shock but was surprised later to find the patient in excellent con-
dition and remarkably free from pain.

January 9, 1905: Since the operation the patient's progress
has been surprisingly satisfactory. Last night her temperature
rose to about 102, but this morning it is 99 and her pulse about
110. She has been taking a moderate amount of liquid nourish-
ment and salt solution enemata. Yesterday and last night she
passed a large amount of flatus and is much more comfortable.
The distention of the abdomen is greater this morning than it

has been since the operation, but there is less pain and the patient is much more comfortable. She has received small doses of calomel to relieve her distention, and this morning in addition to this she was given strychnia.

January 10: Last evening the distention had increased considerably, the patient was very uncomfortable from it,—had some difficulty in breathing and was belching a good deal. I therefore decided to open the wound on the right side and tap the cæcum. This I did without any difficulty at all, administering the patient a small amount of ethyl chloride. The colon was exposed for an area of one and one-half inches, and a small trocar introduced. A quantity of gas escaped through the cannula, which was left in position, and the patient was rendered more comfortable at once. Since doing this, there has been a marked improvement in her condition; she has had two bowel movements and her temperature and pulse are both lower. She looks now as if she would certainly recover.

January 16: Continues to improve, temperature remains about normal. On the sixth day after the operation there was a marked odor to the dressing on the left side, and when I removed the gauze packing there was an escape of gas and some liquid fæces. For twenty-four hours previous to this the patient had been unable to void the urine, and had to be catheterized. Since the change of dressing she has voided her urine. The discharge from the left wound has been quite free, and contains some fecal matter. There has been less fecal matter passed per rectum, and also less flatus. The right wound looks well; it is packed with iodoform gauze down to the exposed bowel, from which there is no leakage. To-day the patient is taking semi-solid food and looks much better. The button has not passed.

January 30: Two days ago, when dressing the left wound, I extracted two large pieces of mucus which looked like sponges. These were evidently sloughs from the colon somewhere and I suspect from the cæcum. After their passage there was some leakage from the small puncture of the cæcum of the right wound. Yesterday I introduced a glass catheter into this opening and passed quantities of salt solution through the colon, washing out a quantity of fæces but no more sloughs. I then injected some salt solution and whiskey which was followed later by malted milk. This was done because the patient declined to take soft

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cient food. She gradually grew much weaker and has been comatose at times. To-day she grew still weaker, and died about 2 P.M.

A post-mortem examination was made by Dr. Longcope, who found that the colon had sloughed at the point of anastomosis and that the button had dropped into a pocket behind the colon.

Comments: A primary resection should not have been done in this case nor should a Murphy button have been used. A lateral anastomosis would have been better than an end-to-end one.

CASE III.—G. D.; female; 68 years of age; Pennsylvania Hospital. Diagnosis: *Partial obstruction and carcinoma of transverse colon and sigmoid. Resection of transverse and descending colon; immediate anastomosis,* March 5, 1905. *Recovery;* well to-day.

I saw this patient in consultation with Dr. David Edsall. The history of active trouble in this case extends over but three weeks. Previous to that time, however, the patient had had considerable trouble with her digestion and, at times, difficulty in having her bowels move. She had also had attacks of acute pain, evidently peristaltic in character. Three weeks ago she was suddenly seized with severe abdominal pain, and her bowels were opened with some difficulty. There was little distention at any time, but there was a great deal of abdominal pain and marked peristalsis. The peristalsis was visible through the abdominal wall. Examination a few days later revealed a mass in the left iliac fossa which was movable and tender; it varied much in size, and sometimes a little kneading would cause it almost entirely to disappear. There was never at any time a discharge of blood or mucus. When, with Dr. Edsall, I saw her we discussed but two possibilities: one, malignant disease of the sigmoid, and the other a chronic intussusception. My inclination was toward the first of these, as the mass seemed hard and there had been no discharge of blood or mucus as would have occurred with an intussusception. The patient was removed to the Pennsylvania Hospital.

I opened the abdomen through the outer border of the left rectus, opposite the spine of the ilium. As soon as the peritoneum was divided there presented in the wound what I supposed to be a dilated colon, but which proved to be the stomach. After

some difficulty I was able to differentiate the various structures and discovered we were dealing with a large malignant mass about the middle of the transverse colon which had gravitated to the left iliac fossa, dragging the stomach with it. Here the mass had become adherent to the sigmoid, the wall of which was involved in the cancer mass, but the sigmoid was not obstructed. The distal portions of the transverse and the descending colon were perfectly flat—contracted, in fact, to about the size of the small intestine. Proximally to the growth there was not much distention. My first idea was to do a double resection, first of the transverse colon and then of the sigmoid. The entire mass was surrounded by omentum. I tied off the omentum close to the greater curvature of the stomach and included in the ligatures the mesocolon, in order to shut off the lesser peritoneal cavity. When I had done this I found that if I resected a proper amount of bowel at the two situations there would be left only about five or six inches of descending colon, and rather than leave this and make two anastomoses I concluded to remove the entire transverse and descending colon with the involved portion of the sigmoid and attach the hepatic flexure of the colon to the distal portion of the sigmoid by the end-to-end method. This I did without any difficulty after the method of Moynihan, using the Doyen forceps. The anastomosis was the most satisfactory one I have ever made; there did not seem to be the slightest possibility of any leakage. Therefore I did not insert a drain, but closed the abdomen in layers. The operation took one and one-quarter hours. The patient was anæsthetized with ethyl chloride and ether. The glands in the mesocolon and mesosigmoid were not much larger than normal. The patient reacted well from the operation. At the beginning of the operation her pulse was 120; at the conclusion it was 90.

March 6, 1905: Her temperature since the operation has not reached 100 and her pulse at one time was 108. This morning it was 88. She has passed urine frequently but without difficulty and also expelled some flatus through the nozzle of a syringe. She has been very troublesome and nervous, but so far as her general condition is concerned she is in excellent shape and, I think, should make a good recovery.

March 13: Since operation the patient has done remarkably well; the bowels have moved freely and, excepting a marked

melancholic tendency, there has been nothing to worry about. For the last day or two she has complained of frequent micturition. To-day I dressed the wound and found the skin lifted up by an accumulation of very odoriferous pus. Quite a little gas escaped when the wound was opened. The skin had healed perfectly; all the stitches were removed. This infection had taken place without disturbing her general condition and without giving her any amount of pain. I believe that the infection is only a superficial one and do not think it is connected in any way with the seat of anastomosis.

March 22: Since the last note there has been more or less fecal discharge every day through the wound; at times it has been quite profuse. Lately there has been a slight rise in temperature at night, but otherwise the general condition seems to be good. Inability to control the urine at times is very distressing to the patient. For three days she has been sitting up in a wheel chair for an hour or more.

March 29: There has been no fecal discharge from the wound for three or four days and her condition is greatly improved, the bowels moving regularly without aid. She is eating much better. She spends four or five hours out of bed every day.

April 2: The wound is healing rapidly, but she developed last night a phlebitis of the left leg.

April 3: The pain in the leg is less but the swelling remains about the same, and there is a slight increase in the pulse rate with no fever.

May 10: She has been doing very well until about two weeks ago, when the sinus was so nearly healed that I thought that I might leave out the gauze packing, which I did for two days. When I came to dress it at the end of this time an accumulation of pus had taken place and some burrowing under the skin externally. Since then there has been more pus and a small amount of fecal matter discharged. To-day I determined in view of the fact that there had been a slight rise in temperature in the evening, that there must be some fault in the drainage, and gave her ethyl chloride, opened up the wound thoroughly, curetted out two pockets and packed it with gauze.

May 22: Wound has been rapidly contracting and her general health has been much better. She is able to go about and is going home to-morrow.

May 1, 1909: Patient's wound has remained healed and she is well to-day; no evidence of recurrence.

Comments: Probably a lateral anastomosis here would have given a better result, or perhaps a drain might have shortened the convalescent period.

Pathological diagnosis: Polypoid adenocarcinoma and tuberculosis of colon.

CASE IV.—J. S.; male; 40 years of age; Pennsylvania Hospital. *Tuberculous strictures of ileum; tuberculous peritonitis. Resection of ileum and cæcum,* September 28, 1905. *Second operation,* January 20, 1906, *for fecal fistula. Lateral anastomosis of ileum and transverse colon. Third operation,* January 11, 1907, *same condition; lateral anastomosis of ileum and sigmoid. Fourth operation,* May 1, 1907; *resection of transverse colon with a portion of the ileum. Fifth operation,* May 19, 1907; *jejunostomy. Died* May 21, 1907, *twenty months after his first operation.*

This patient, a negro, had been in the hospital ten days or two weeks. His symptoms were so obscure that it was impossible to make a diagnosis. He complained of general pain in the lower half of the abdomen, with considerable disturbance of digestion. He said he had vomited, but he vomited only once or twice after his admission. A test meal was given but nothing abnormal was found in the examination. His abdomen was always scaphoid and somewhat rigid. On the right side in the iliac region, on two occasions I thought I felt a distinct movable mass which was probably an enlarged gland. There was no fever at any time and no blood or mucus in the bowel movements. A rectal examination showed some tenderness behind the bladder. After keeping him under observation for a number of days I concluded that he had probably a tuberculous peritonitis, and that an operation was justifiable. When the abdomen was opened through the right rectus the first thing which the hand encountered was the ileum very much contracted at two points, one near the cæcum and the other a number of inches away from it. These areas of contraction were probably one and one-half to two inches in length and the whole thickness of the bowel was involved, the peritoneal coat being studded with small tubercles. The mesocolic glands were enormous; the mesenteric glands on either side of the diseased ones seemed perfectly normal. There

was not an excessive amount of fluid in the peritoneal cavity. There was no evidence of tuberculosis elsewhere. I determined to excise the entire diseased area together with the cæcum and the enlarged glands. In order to get out all the glands and the mesentery which contained them, I found it necessary to divide the ileum at least 12 to 18 inches away from the proximal side of disease. The colon was divided at the middle of its ascending portion and its end inverted by two rows of sutures—one of catgut and one of celluloid thread. The same was done with the end of the ileum, and then a lateral anastomosis of the ileum and transverse colon was made with the Doyen forceps. The operation was perfectly clean and there was no possible soiling. It occupied a very long time, two hours and ten minutes. This was partly due to the fact that after making one division of the ileum and inverting the ends, I found it necessary to go higher up on the bowel because of the enlarged glands in the mesentery. On examining the specimen after removal it was found that the distended portion between the two strictures contained several ounces of watermelon seeds. He said that he had not eaten watermelons for nearly a year, but considering the season and the tendencies of his race this is to be doubted.

September 30, 1905: He has done very well since the operation and shows no bad symptoms at all.

October 2: He had considerable pain in the abdomen last night and vomited. To-day his abdomen is rigid and there is some soiling of the gauze drain which was introduced. Ethyl chloride was administered and the drain withdrawn. There escaped a quantity of gas and considerable liquid fecal matter. This leak, I think, comes from the inverted ends of the bowel as the gauze drain extended down to this point and not to the point of anastomosis. Notwithstanding this leak he is now comfortable and the bowels have moved. A fresh gauze drain was introduced. The patient was discharged December 19 with a small sinus.

January 20, 1906: The patient has improved a great deal since his first operation but has continued to suffer from a slight fecal fistula. The discharge from this fistula is almost liquid, but at times—the patient says—fecal matter comes out. He complains also of painful peristalsis, and I had an opportunity

to observe this in a distended coil of bowel extending from the left iliac fossa up in the direction of the wound. Thinking that possibly the fistula led to the blind pouch of colon left at the previous operation, I determined to make the incision on the outer side of the old scar, and this I did. Before being able to make out the situation, however, I was obliged to separate the fistulous opening in the wall from the bowel and do considerable separation of adhesions. Finally I discovered that the fistula opened into the bowel probably at the point of anastomosis. The proximal portion of the ileum was enormously distended and hypertrophied. This extended up for about two or three feet. The colon was quite collapsed. As the intestines were so matted together in the right upper quadrant I determined to make a new anastomosis between the ileum and the transverse colon, and this I did after the manner of Moynihan. The fistulous opening into the bowel I closed with two catgut sutures and introduced a drain down to this point. The new anastomosis was surrounded by omentum and the abdomen closed, excepting at the point of drainage.

January 22: Patient is more comfortable to-day and has done remarkably well since his operation.

March 1: Patient was discharged from the hospital to-day, the sinus still persisting but no fecal discharge.

January 11, 1907: Since his last operation he has been free of pain and has gained considerably in weight. The fecal fistula redeveloped, however, and has continued open ever since. In March, Dr. Le Conte operated and tried to close the fistula, but unsuccessfully. There is no longer any painful or visible peristalsis, but large quantities of fecal matter escape through the fistula. I determined that the best thing to do was to open the abdomen on the left side, divide the ileum near the old point of anastomosis and attach the proximal end by lateral anastomosis to the sigmoid. I opened the abdomen through the sheath of the left rectus and found the abdominal cavity in good condition excepting for numerous small tubercles over the bowel and mesentery. There was no fluid and no enlarged glands. The last anastomosis was in good condition and working. There was no hypertrophy or distention of the bowel. At the second operation I did not divide the ileum but simply made a lateral anastomosis. To-day I cut the ileum near the old anastomosis.

inverted the two ends and attached the proximal portion to the upper portion of the sigmoid by a lateral anastomosis. The steps of the operation were easily performed and the result apparently was very satisfactory. The abdomen was closed without drainage. I did not do anything to the fistulæ on the right, hoping that they would close.

February 4: Since this operation the patient has progressed very satisfactorily. At first there was free discharge of fecal matter from the old fistula, but this stopped after a few days. The fistula was Y-shaped, having two external openings, one of which closed very promptly after operation, but the other is still discharging a small amount of mucus and pus. The patient's temperature is normal and he is able to move about and is quite comfortable.

The specimen removed at the original operation was exhibited at the meeting of the Philadelphia Academy of Surgery held on February 4, 1907. " It is 38 cm. long, 34 cm. of ileum and 4 cm. of cæcum. The mesentery is attached to the intestine and contains a number of enlarged glands. There are two constrictions, one 5 cm. from the ileocæcal juncture, and the other 13 cm. above this one. The bowel between the two constrictions is very much distended and thickened; in this distended portion between the two constrictions there were found, when the specimen was examined, two or three ounces of watermelon seeds with one grape seed. The peritoneal covering of the bowel and mesentery was studded with small tubercles, and numerous hard bodies can be felt in the intestinal wall. The mesentery is very thick and contains a number of large glands, the largest measuring 4 x 3½ x 2 cm. These glands on section proved to be caseous. The appendix is tightly bound down to the cæcum by adhesions. The lower stricture is 3 cm. in length and the lumen of the bowel at this point ½ cm. The second stricture is 1 cm. in length and the lumen 1½ cm." The pathological diagnosis was tuberculosis of the intestine with chronic ulceration; tuberculosis of the mesenteric glands, and hypertrophy of the muscular wall of the intestine.

May 1, 1907: Since the last operation the patient's general health has been very good, but there has continued to discharge from the sinus a quantity of pus and mucus. He says fecal material at times also passed out, but I have had his dressings

carefully watched for several consecutive days at the hospital, bringing him in for this purpose, but have found no fecal matter. He is very much disturbed by the discharge and the necessity of constant change of dressings, so I determined to open the abdomen again and remove all of the bowel that had been side-tracked by the last operation. To-day I opened the abdomen through the right rectus and excised the colon from the splenic flexure back to the point of original excision. Together with this bowel there were removed two feet of ileum. At the point of division of the colon the bowel was perfectly healthy, and I had no difficulty in turning it in. The whole intestine was one mass of adhesions and I had considerable difficulty in isolating the portion which I wished to remove. A thorough twisting and malposition of the small intestine made the operation long and difficult. The only portion of the bowel removed which was really distended was the ascending colon, and that was filled with tuberculous ulcers of the mucous membrane. The peritoneum generally was in much better condition than at the previous operation, and at several points on the small intestine there were cicatrices of healed tuberculous lesions. When I removed the bowel I felt that I had taken out all the diseased tissue except a few mesenteric glands, and hoped that the patient would be entirely relieved. The abdomen was closed without drainage excepting for a small piece of gauze extending just through the abdominal wall at the seat of the old fistula. The operation lasted about two hours.

May 3: Patient's temperature has remained normal since operation; he has had no vomiting, no distention, and his general condition has been very good.

May 21: The patient did very well for several days after his last operation. Then he began to have fecal discharge that I judged came from the loop of small intestine that had been adherent to the old abscess and which I had tried to cover with peritoneum. Discharge has increased during the last few days and the patient has emaciated a great deal. I tried rectal feeding, but this did not help matters. To-day I decided to do a jejunostomy or resection of the perforated bowel. The patient was in very poor shape. He was put on the operating table and four pints of normal salt solution put into his circulation. Under morphia, ethyl chloride and ether anæsthesia the normal sal

opened up, the loop of bowel delivered, and the perforation found. It was too large to close, and after thoroughly cleansing the cavity the bowel was fastened in the wound with gauze packing and a tube passed down into the distal portion of the loop and fixed with a purse-string suture. The patient was immediately given a pint of salt solution and two ounces of whiskey through the tube.

May 20: Patient is in pretty bad shape, although he was much better last night than before his operation. He has been given raw eggs and peptonized milk through the tube every three hours and has vomited small amounts at times to-day. His temperature is subnormal and he seems in pretty bad condition.

May 21: Patient died to-day. At the postmortem his entire intestinal tract measured but 19 feet.

CASE V.—S. B.; female; 57 years of age; Pennsylvania Hospital. Diagnosis: *Obstruction of bowels due to carcinoma of sigmoid. Operation: Colostomy, and eight days later resection and anastomosis. Recovery, with death from recurrence one year later.*

This patient was a rather thin person who gave a history of ribbon stools for some time with marked constipation. She stated that she had never passed blood excepting after the use of an enema and then only a slight amount. Had never had any previous attack of obstruction. She was a Christian Scientist, and her treatment was confined to this art until about a week ago when constipation became much more marked; she then took castor oil. For forty-eight hours she passed neither fecal matter nor gas, her abdomen becoming more and more distended, and she has vomited everything that has gone into her stomach. When I saw her at about 10 P.M., her condition was good,—the abdomen was markedly distended, coils of bowel and peristalsis being plainly visible through the abdominal wall. Dr. Lee had examined the rectum and could feel nothing abnormal. The sigmoid could be felt, and was markedly distended. Most of the pain and tenderness was located about the cæcum. I urged immediate operation, with the intention of establishing an artificial anus and later removing the cause of obstruction if it were removable. The abdomen was opened through the left rectus and a growth about the middle of the sigmoid readily found. There were a number of enlarged glands in the mesosigmoid.

The growth was of the contracting variety and had completely shut off the bowel. I had no difficulty in delivering the intestine, and then made an anastomosis between the bowel above and below the growth by means of a Murphy button. I left this knuckle of bowel completely outside the wound. In a few days, the patient being in better condition, I intended to resect all the involved intestine. I was greatly tempted to do this at the time of operation because the patient seemed in good condition, but because of past experience and the experience of others deemed it unwise.

September 10: Although patient has passed some flatus there has been no bowel movement. Some distention still exists and patient is very uncomfortable. To-day I opened the distal portion of the bowel; a prompt escape of a large amount of gas and fecal matter followed.

September 16: Two days ago, eight days after first operation, I resected the involved sigmoid. Patient had improved a great deal and seemed in good condition. I found that the wound had become infected from fecal discharge and had therefore to exercise great care to prevent infection of the peritoneum. The area was well walled off and I was able to draw the bowel out very satisfactorily. I made a wide resection of the involved portion, invaginated the two ends and did a lateral anastomosis, using linen thread. The operation was easily accomplished and satisfactory in every way. A small drain was put through the peritoneum in the middle of the wound and another down to the peritoneum at the upper angle where the infection had occurred. The patient stood the operation well and is now in good condition; her only complaint is of gas. She made a very satisfactory convalescence and was discharged October 12. 1907.

January 21, 1908: Patient came in to-day; seems perfectly well; weighs 104 pounds. Thinks she weighed 80 when she went to the hospital; weighed 79 pounds when she left. Bowels move regularly without a laxative.

June 2: Patient complains of considerable lassitude and says she has some abdominal pain. Bowels are moving, however, and I can feel no evidence of any recurrence. She thinks she has lost weight, but her weight is exactly what it was on her last visit.

July 22: Patient has been seen by a physician who told her

she had a recurrence of her trouble and that all he could do for her was to make her comfortable. This has depressed her very much and tended rather to aggravate her symptoms. She says that she sleeps badly, her appetite is poor, and that she has almost constant pain in the left iliac fossa. The bowels, however, move regularly from cascara, and there has been no blood or mucus in the movements. Weight, 92½ pounds. On examination there is some hardness to be felt to the left of the wound, but it feels as if it might be in the abdominal wall. I am by no means sure she has a recurrence but have advised X-ray treatment, for which she will go to Dr. Manges.

Patient, a few weeks after this note was made, died from recurrence, but had no obstruction.

CASE VI.—M. W.; female; 58 years of age; Jefferson Hospital. Diagnosis: *Carcinoma of appendix and cæcum. Resection of cæcum, lateral anastomosis, October 5, 1907. Death on seventh day after operation.*

This patient was referred to me by Dr. Robert L. Gibbon, Charlotte, N. C. She had always been healthy, and had given birth to eight children. In February, 1906, she had an attack which was diagnosed as appendicitis. Was ill a week; the symptoms disappeared under rest and ice. Six weeks later she had a second attack which lasted but a few days. A marked symptom in these attacks was severe localized pain and slight temperature. No nausea or vomiting and no urinary symptoms in either of these attacks. She remained well until six weeks ago, when she had another attack similar to the first but more marked. There was considerable fever and, excepting for the nausea, the symptoms were typical of an acute appendicitis. In this last attack a mass could be felt in the cæcal region. She gradually improved and was quite comfortable when I saw her. Examination of the abdomen was negative excepting for a tender and slightly movable mass in the right iliac fossa. In view of the history and the absence of other symptoms it seemed likely that this was a case of appendicitis with a walled-off abscess. I advised operation, and two days later, October 5, I operated at the Jefferson Hospital.

The abdomen was opened through the right rectus and a hard mass encountered behind the cæcum. There were no omental adhesions. General abdominal and pelvic cavities were walled

off and a line of cleavage sought between the mass and the neighboring viscera. The mass was so dense that I feared I was dealing with a malignant growth. Finally I got the cæcum separated. When brought to the surface I found that the appendix had separated at its attachment and that there was quite a large opening in the cæcum. Where the appendix was detached there was evidently a malignant growth, and on examining the interior of the cæcum I found that this growth extended across the lower end of the bowel and up as far as the opening of the ileum. I then proceeded with a resection of the cæcum, going 6 or 8 inches above the growth and making a lateral anastomosis between the ascending colon and the ileum, using linen thread for the purpose. When I had completed the anastomosis I proceeded to get out what remained of the appendix; this was a difficult undertaking, as it was tightly bound down. The distal portion of the appendix, however, did not seem to be so much diseased as the proximal portion. It was impossible to ligate the mesoappendix as I simply had to dig the appendix out of its bed behind the cæcum. A gauze drain was put in and the wound partially closed.

October 8: Patient has done only fairly well since operation. Yesterday morning she seemed in good condition: but in the afternoon she suffered a great deal from nausea but vomited only once or twice, and then only small quantities. She voids urine voluntarily; her temperature range is between 99.2° and 101°. She has taken very little nourishment and drinks water in small quantities. The bowels have not moved though she passed some flatus to-day when an enema was given. There is no distention of the abdomen; the tongue is moist. Nausea and backache are the only complaints which she makes. Pulse has been somewhat rapid, ranging from 110 to 130.

October 9: Patient is better, though still has occasional nausea. She has complained of distention, but this is not perceptible, and has passed large quantities of gas by the bowel. Last night she had a slight movement following an enema. She has taken little in the way of nourishment excepting peptonoids, but she has had nutrient enemata. She passes a good quantity of urine. Her temperature varies from 99.2° to 101°.

October 11: Patient's bowels have moved very satisfactorily and a number of times. There is no vomiting but the nausea

continues, although she is able to take a certain amount of liquid nourishment and stimulation. Her temperature continues around 100° and 101°. Her pulse remains between 110 and 120. There has been a decided falling off in the urine and to-day she has passed little or none.

October 12: Her condition yesterday grew much worse. She was in a stuporous condition all day, secreted very little urine and declined to take nourishment. The bowels moved five or six times. I changed the drain the day before, and although it was soiled and had a bad odor there was no escape of fecal matter or pus on its withdrawal. Her condition continued to grow rapidly worse and she died at 4 o'clock this morning. It is hard to know exactly what caused this death. There is no doubt that the anastomosis was working perfectly satisfactorily. There was no distention and no vomiting, so I felt if there was a peritonitis it must have been a low grade of infection. There was some kidney secretion in the last twelve hours, but I think that the kidneys were largely the cause of the death.

Pathological diagnosis: Cylindric-celled carcinoma arising from an adenoma.

CASE VII.—G. N.; male; 33 years of age; Jefferson Hospital. Diagnosis: *Carcinoma of ascending colon*, March 28, 1908. *Recovery; well at the present time.*

This patient gave a history extending over 6 or 8 months. During this time he has had considerable soreness and tenderness in the right upper quadrant of the abdomen, in which a tumor has developed. He has had very black, tarry stools. Has never vomited, and pain is uninfluenced by eating. He has no pain referred to the shoulder or back. There is no apparent distention of the stomach. Examination shows a marked rigidity below the costal border and the sensation is conveyed to the hand as of a tumor beneath the upper half of the right rectus; it is exactly in the position of the gall-bladder. There is no history of colic, and I was inclined to believe that he had a duodenal ulcer with a mass of adhesions about it. Others thought that the tumor was probably a gall-bladder. His hæmoglobin was 65 per cent., but he had a good proportion of red blood cells. His bowel movements were very black, but it is reported that no blood was found. I opened the abdomen through the right rectus and found a large growth in the hepatic flexure of the colon, covered by adherent

omentum. There was no extension to the gall-bladder or liver, but there was an extensive involvement of the colic lymph-nodes. The patient was in no condition to stand an extensive operation: his pulse became quite weak on the table. I determined that it was worth while to attempt an excision of the growth, but thought it wiser to do the operation in two stages. I therefore divided the ileum near the ileocolic juncture, closed both ends and then made a lateral anastomosis (Moynihan's method) between the proximal portion of the ileum and the transverse colon. I put in a small drain down to the closed distal end of the ileum.

April 1: Patient is in good condition. Drain was changed to-day. I think in two or three days I will be able to complete the operation.

April 11: Patient has improved very much since the first operation, and seems in good condition to stand the second. The abdomen was opened through the same incision in which the drainage had been going on, and in which there was a slight infection. I had no difficulty in bringing up the cæcum and ligating its mesentery. I then divided the transverse colon and inverted it. In bringing the mass out of the abdomen, I was surprised to find a coil of small intestine adherent on its inner posterior aspect. On careful examination this proved to be the duodenum. At first it looked as if a resection of this portion of the bowel would also be necessary, but I found when I separated it that practically only its peritoneal coat was involved in the mass. Several sutures were put in to repair the loss of the peritoneum. There was no involvement of the liver or gall-bladder in the growth. The kidney was thoroughly exposed, but there was no extension of the disease to it. A posterior drain was carried out through a puncture in the loin. A small drain was then carried down to the inverted colon and another placed in the superficial wound at its lower extremity. Patient stood his operation well, considering the great extent of it.

April 15: Patient's condition is very satisfactory. Two days ago I was worried because he had considerable cough, which is probably due to the fact that he is a miner and has a miner's lung. His bowels have moved well.

April 24: Patient is making a very satisfactory recovery, although there has been considerable discharge of the wound, which was infected at the time of the second operation. Patient is sitting up and his bowels are moving normally.

May 17: Microscopical diagnosis: cylindric-cell epithelioma. Wound entirely healed. Patient gone home.

February 12, 1909: Letter from Dr. G. A. Cunningham, the patient's physician: "He has gained thirty pounds, has no indigestion, flatulence never occurred; he is now engaged at the laborious task of coal mining, but has had no complaint of any kind regarding weakness of the abdominal wall. He has had no medical assistance whatever since the operation. His bowels are regular."

CASE VIII.—M. A.; female; 71 years of age; Bryn Mawr Hospital. Diagnosis: *Acute intestinal obstruction due to carcinoma of splenic flexure. Colostomy, May 12, 1908, followed by resection May 20, 1908. Death June 6, 1908.*

This patient has had more or less trouble with her bowels for about a month, and during the last four or five days has had difficulty in having a movement. When I saw her just before operation her abdomen was distended; there was no evidence of fluid and she was vomiting. Her temperature and pulse were normal and she seemed in good condition. I thought it wise to operate at once, and as I believed the obstruction to be in the upper rectum, I made an incision through the outer portion of the lower left rectus. The small intestine was considerably distended and filled the pelvis. The rectum, sigmoid and descending colon were collapsed. The transverse colon was distended. Passing my hand up to the splenic flexure I found a small hard mass in the bowel. Instead of making a lateral anastomosis between the transverse colon and the sigmoid, which I could easily have done, I made another small opening in the upper portion of the rectus, hoping that I might be able to deliver the growth through it; I found, however, that it was situated just at the splenic flexure and that only with great tension could it be brought within the wound. It was about the size of a hulled walnut and was shaped like a Murphy button, and apparently completely obstructed the bowel. I then made an opening in the transverse colon after fixing it in the wound. I used Stewart's method for draining the bowel.

May 20: Patient has made a very good recovery from first operation, and to-day I undertook the removal of the growth. I first closed the colostomy opening, increased the wound, tied off the gastrocolic omentum, divided the colon proximal to the

colostomy wound, and then proceeded to remove about 8 inches of the transverse colon together with the splenic flexure in which a small hard growth was present. I also removed about 4 inches of the descending colon. I had considerable difficulty in separating the growth from the spleen, and in doing so tore off a small portion of the spleen, which caused a rather profuse hemorrhage, which was controlled by a pack. The mesocolon was so short that it was difficult to get the ligatures behind the growth. I finally managed to get the growth out fairly satisfactorily. There was present a small hard nodule in the kidney, but I could not make out that it had any connection with the growth in the colon. The ends of the divided colon were inverted and a lateral anastomosis made. Catgut sutures were used for the deeper suture and linen thread for the outer. The operation was an extremely difficult one and required about an hour and fifty minutes for its performance. I think it would have been easier if I had made a lateral anastomosis and short-circuited the growth at my first operation instead of doing a colostomy. The removal of the splenic flexure would have been just as difficult, however, but the operation would have taken less time. The patient stood the operation fairly well.

May 25: For several days after operation she had a great deal of nausea and vomiting. Gastric lavage relieved the vomiting. During the past two days she has had a bad attack of diarrhœa; during the last 24 hours but 15 stools, but in the previous 24 hours 28 stools. These occurred without the administration of any laxative whatever. Irrigation of the rectum relieved her a great deal and she is much better to-day. There is a good deal of odor about the wound and the drain has not yet been changed. Her temperature range is between normal and 100°. Her pulse, which was quite rapid on the day after operation, reaching about 160, has recently remained in the neighborhood of 100.

May 26: To-day I removed the packing. There was no bleeding; the wound is very foul and there is some sloughing along the muscle edges. She is still very weak but the diarrhœa is much better. The great difficulty is to get her to take sufficient food. She has been gotten up into a chair and put out in the yard, which I hope will help her.

May 28: Fecal fistula has developed—but free stools by rectum.

was markedly distended and the vomiting was more or less persistent, but not of a fecal type. Palpation showed some rigidity in the region of the sigmoid, but more in the upper right quadrant. The ascending colon seemed to be distended, and as there was much tenderness over the sigmoid, I concluded the obstruction was probably at this point.

Following a hypodermic of morphia and atropin, she was given ethyl chloride and ether, and the abdomen opened through the left rectus. I found the descending colon very much distended, and on withdrawing the sigmoid came at once upon the cause of the obstruction, which was a growth involving the interior of the bowel and producing so marked a constriction as to practically completely obstruct it. Only one gland could be felt in the mesentery. About 6 inches of bowel was excised, including the growth, and a lateral anastomosis done. The ends of the bowel were inverted with catgut and silk and the anastomosis made with catgut and silk; as the operation was accomplished outside of the abdomen and the wound well protected with gauze, no drainage was inserted. While the abdominal wound was being closed a rectal tube was inserted into the rectum and a quantity of gas and liquid fæces escaped and the abdominal distention at the same time disappeared.

February 8: The patient's wound is healed and there is no pain or abdominal tenderness. The abdomen has been perfectly flat ever since her operation. During the last few days she has been vomiting and has had a very troublesome diarrhœa, I am told. The night before last she vomited practically everything that was taken. I talked with Dr. Holcombe over the 'phone and advised that her stomach be washed out. To-day I got a very good report from her. There has been no vomiting since yesterday morning, the bowels have moved but once, and she has been able to retain liquid food.

February 14: I had supposed that this patient was doing very well until last evening, when I received a telephone message saying she was in a bad condition and that a mass had developed in the left loin. I felt sure that there had been a leak at the site of anastomosis, and advised that the wound be laid open freely, and arranged to see the patient to-day. When I arrived I found her in an extremely low condition. On removing the dressings I found them soaked with a quantity of dark liquid fecal matter.

The wound had opened throughout its length and there were great masses of necrotic muscle and fascia. I suppose she got rid of probably a pint of fecal material, and I hoped that its removal might bring about some improvement in its condition, but was informed later that she gradually sank and died this evening. She had no further obstructive symptoms at any time and her abdomen was not distended when I saw her; on the contrary it was scaphoid. I think that there is no doubt that this death resulted from toxæmia, the result of extravasation of intestinal contents around the anastomosis.

There are a number of practical points in regard to resections of the colon about which there is great variety of opinion and practice, and most of these points are brought out in the foregoing cases. Using these as a basis, I propose to discuss the following questions. First, where should incision be made in operating for diseases of the colon? Second, is one justified in doing a resection and an anastomosis in the presence of acute obstruction, or should the obstruction first be relieved by drainage? Third, what are the relative merits of end-to-end and lateral anastomosis? Fourth, what is the best method of making the anastomosis? Fifth, should drainage be used if the peritoneum is not already infected? Sixth, to what is the operative mortality due? Seventh, is ultimate mortality due to too limited excision of the bowel?

1. In answering the first question I would say that the incision should be made as nearly as possible over the growth, and if one has been unable to locate the growth, and operates simply for the obstruction, and finds that he is unable to gain ample access to the involved bowel, then a second incision, through which the bowel may easily be drawn, should be made. A second incision is much less objectionable than the injury to the bowel through an incision which does not permit of easy handling.

2. Regarding the second question, as to resection and anastomosis in the presence of obstruction, there can be little doubt, all surgeons having agreed that however easy the

operation is it should never be done. This conclusion was reached after sad experiences, to which I think my first and second cases and possibly my tenth case, might be added. In 1903 F. T. Paul (*Brit. Med. Jour.*, Aug 15, 1903) said that obstruction more than trebled the danger of colon resection, and he reminded us that even after a simple colostomy, done for obstruction of two or three days' standing, the patient may be in a precarious state for two or three weeks, even though apparently greatly improved for twenty-four hours. There is sufficient auto-intoxication, even when the drainage operation is done fairly early, to cause severe poisoning which is characterized especially by a foul diarrhœa, loss of appetite, slight fever and general depression. This condition is well shown in Case VIII of my series, and is a picture, I am sure, familiar to us all. Not only is the patient absorbing toxins from the intestinal fermentation, but ulceration of the colon, well above the obstruction, in these cases is quite common. To do a formal resection, however quickly and easily, at this time is to invite disaster. Moynihan (" Abdominal Operations ") says, " There are few rules so binding upon the surgeon as that which prohibits the resection of growths and subsequent end-to-end anastomoses of the large intestine in cases of acute obstruction." One is strongly tempted to break this rule when the growth is easily accessible, as it is in the transverse and sigmoid colon, but there is every reason why he should refrain. Experience has taught surgeons everywhere this lesson, and it should not be forgotten.

A few successful resections and anastomoses of the upper portion of the small intestine for acute obstruction may mislead the operator to the false conclusion that the same procedure will work as well in the case of the colon, but the question is an entirely different one. The small upper portion of the intestine is comparatively free from bacteria, while the tract of the large intestine teems with them, and it is this fact that accounts for the peritonitis so frequently observed in cases of long standing obstruction of the lower intestine. The bowel wall becomes distended, its circulation bad and the organisms make an easy exit into the peritoneal

cavity. It is a well-known fact that the lower down in the intestinal tract an obstruction is the greater is the infection from the absorption of the intestinal contents, and this is due not to the greater absorbing area but to the greater number of pathogenic organisms in the lower portion of the small intestine and colon. Numerous have been the contributions to surgical literature in recent years showing the danger of this absorption even after a perfect resection and anastomosis. Monks and others have laid great stress upon the importance of emptying the bowel above the obstruction at the time of the operation, and his work and experiments in this matter have contributed largely to our improved results. He has shown us how a large portion of the small intestine can be emptied by puckering the intestine up on a large blunt tube passed into its interior, and that this is the only way in which it can be accomplished. The toxicity of the intestinal contents in acute obstruction is well shown by the experimental study made by Clairemont and Ranzi (" Proceedings of the German Medical Congress, 1903"; ANNALS OF SURGERY, December, 1903.). Their results are as follows: " The intestinal contents above the stenoses, after being rendered free from bacteria by filtration, always proved poisonous, whether administered intravenously or hypodermatically. Bouillon cultures of small quantities of the intestinal contents after four to five days gave toxins equally poisonous. Thus the poison is the result of bacterial growth. It can also withstand heat. The toxic action can be paralyzed by mixing the material with the brains of normal rabbits or guinea pigs The filtered intestinal contents in some instances showed intense hæmolytic power when administered to dogs or horses It was impossible to establish either active or passive immunity to the poisons. which seem to show that an extension of serumtherapy to the treatment of ileus is impossible." William J. Mayo (*Jour. Amer. Med. Assoc.*, September 14, 1907) says that a fair proportion of the mortality following resection for obstruction is due to perforation from thrombosis, and he therefore urges great care in the handling of the distended bowel on this account. He advises treating the

collapsed bowel up to the obstruction rather than the dis-
tended bowel down to the obstruction. Here, then, we have
another reason for primary drainage of the large intestine
in cases of obstruction before doing an anastomosis.

I think my own cases bear out all these points. In two I
did a resection in the presence of an acute obstruction and
lost both. In two others I did the drainage operation first
and the resection later. One died and one recovered. In
my last case I did a primary resection because I thought that
as the obstruction was not complete there would be little
danger from auto-intoxication, the result of absorption. As
I have said before, this, I believe, was an error. What then
should be the procedure in these cases of acute obstruction?
Moynihan recommends Paul's operation, which consists in
loosening the bowel from its attachment, bringing the growth
out through the wound, dividing the bowel well above and
below the growth, and inserting into the proximal and distal
ends two glass tubes connected with a rubber drainage tube,
and then the removal of the growth. By this operation the
growth is removed at once and free drainage of the bowel
is accomplished. Later, an anastomosis is accomplished by
a crushing forceps and the fecal fistula closed. Von Mikulicz,
Hartmann, and Mayo, all suggest methods quite similar to
those of Paul. There is no doubt that these methods are
superior to colostomy performed above the growth, as it
renders subsequent operation very simple and easy. Where
the growth cannot be delivered easily into the wound colos-
tomy may be done or the obstructed portion of the colon may
be side-tracked by performing ileocolostomy or colocolostomy.
This method I pursued in one of my successful cases (Case
VII). These operations are particularly advised where the
obstruction is only partial, and sometimes are advantageous
where there is no obstruction.

3. The relative merits of the end-to-end and lateral anas-
tomoses depend largely upon the portion of bowel with which
one is dealing. As a rule there is greater likelihood of leak-
age in the end-to-end operation because of the difficulty of
getting an accurate and tight approximation of the two por-

tions at the mesenteric attachment. It can, I think, be said that unless the peritoneal coat can be brought in from the two lateral aspects and made to cover the divided mesenteric attachment a lateral anastomosis should be done. In the ascending and descending colon, and at the hepatic and splenic flexures, a large portion of the posterior aspect of the bowel has no peritoneal coat, and the mesentery is short and wide, so that here there is no chance of making a complete peritoneal approximation in an end-to-end anastomosis, and therefore the lateral method must be employed. In the transverse and sigmoid colon the entire bowel is covered with peritoneum, and it can be drawn in over the mesentery. It is only in these situations that the end-to-end method should be used. Even in the transverse colon and the sigmoid, I would prefer the lateral approximation. In resection of the cæcum, the ileum should be anastomosed with the transverse colon under the omentum, and by the lateral method. End-to-side anastomosis is more difficult and not, I think, as satisfactory. Another great advantage of the lateral anastomosis is that if properly done there is little drag upon the line of suture. In order to prevent this drag the two portions of bowel beyond the anastomotic opening in both directions should be approximated by several interrupted sutures. Many of the failures due to leakage in end-to-end anastomoses have occurred because an unhealthy portion of bowel was involved in the anastomosing sutures. This is much less likely to occur in the lateral anastomosis, and the surgeon knowing that he is going to perform a lateral anastomosis is much less likely to leave any of the diseased bowel. The argument that more time is required for the lateral anastomosis, is without weight as a rule. Still another point in favor of the lateral anastomosis is that there is no danger of stricture developing at the line of anastomosis, as there certainly is in an end-to-end suture. Moynihan lays great stress upon the importance of dividing the bowel obliquely, especially where an end-to-end anastomosis is to be made, as in this way there is less danger of including in the sutures a portion of intestine the circulation of which may be impaired. If

reports that he has done seven resections of the cæcum and ascending colon with end-to-end anastomoses. In this series there was one death due to leakage. His more recent practice is to employ the lateral anastomosis. Bilton Pollard (*Brit. Med. Jour.*, Jan. 23, 1904) advocates the end-to-end method and reports several successful operations done for carcinoma. Another strong advocate of operating in two or more stages is Neumann (*Deut. Med. Wochenschr.*, xxxii, No. 14), who details six cases of carcinoma of the colon in which he first practiced drainage and later resection. His results would certainly warrant his conclusions. Jonas (*Jour. Amer. Med. Assoc.*, Sept. 15, 1906) reports 16 cases of cancer of the colon in 15 of which resection was done. In this series he had 12 operative recoveries and three deaths. The three deaths were all due to a leakage at the point of anastomosis, and in each of these a Murphy button had been used.

In the first three of my own cases I did an end-to-end anastomosis; death occurred in one eight hours after operation, and leakage in the other two; in one a Murphy button was used, and perforation took place and the button dropped out of the bowel into a pocket behind it. Death occurred on the twenty-third day. In the third case simple suture was used, and the patient recovered in spite of a fecal leak and remains well to-day. In the last seven cases lateral anastomosis with simple suture was done. Leakage occurred in three and death in two cases. One died on the twenty-fifth day and one on the fourteenth. My own experience, then, tends to confirm that of the other operators already quoted who favor lateral anastomosis.

4. As regards the best method of making the anastomosis, I would say that it is difficult and practically useless for one operator to say what is the best method of suture to be employed by another in making intestinal anastomoses. I would advise one to use that method with which he is most familiar and which has given him the best results. There is one exception to this statement, however, and that is that some method of suture is far preferable to any mechanical device such as a button or a bobbin. I employed the Moynihan

operation, done with the aid of the Doyen forceps, in all of my cases excepting Case III, in which the Murphy button was used with subsequent necrosis and perforation. In my recent cases I have used a through-and-through suture of catgut and reinforcing suture of celluloid thread or silk. Some such forceps as those of Doyen facilitate the operation considerably, as they control the fecal current and also enable the operator to manipulate the bowel with the least possible traumatism. I have never used the Magraw suture, but those who have speak well of it. Most surgeons have now become convinced that the large intestine is no place for the Murphy button, and no one has tried to impress this upon the profession as much as Murphy himself. He states (" Year Book of Surgery, 1908 ") that for years he has advised against the use of the button in large intestine anastomoses excepting possibly in lateral anastomoses high up in the colon, and in these cases the oblong button should be used. This advice probably answers the question as to the utility of the button in these cases—and my own experience confirms it. Numerous cases have been reported in which the button has either become blocked by a mass of fecal matter, or in which pressure from it has produced necrosis and leakage. This is well illustrated in my second case.

· 5. Should drainage be used if the peritoneum is not already infected? This question is not so easily answered. Given a case in which there is no obstruction, no peritonitis, the bowel wall healthy at the lines of resection, and the intestinal tract well emptied before operation, I should use no drainage. This proposition, however, presumes an early diagnosis, which is by no means a rule in cancer of the colon, and a thorough preparation of the patient before the operation. In but two of my cases did I close the abdomen without a drain; one got well in spite of a leak, and is well to-day, four years after operation: the other died on the fourteenth day with leakage due to sloughing of the bowel at the line of approximation. This was Case X, and I believe that it might have been saved had a Paul's operation been performed instead of an immediate anastomosis. In the

eight other cases I used drainage and had a fecal leak in but three; one was the case in which the Murphy button was employed, and who died on the twenty-third day; another recovered in spite of the leak, and the third died on the fifth day. I believe that leakage does not depend so much on drainage or no drainage as on the character of the intestine and the accuracy of the suture. My own greatest error in this series was in doing resections without first draining the bowel thoroughly, the result of which was that the proximal portion of the bowel was in poor condition and the anastomosis put to the severe test of having to stand at once the strain of the passage of hard masses of fecal matter and a quantity of irritating and septic intestinal contents. I believe on the whole that drainage is better than no drainage in large intestinal anastomoses. The drain should be a small one and should not rest directly upon the line of suture, as this only invites a leak.

6. To what is the operative mortality due? One of the surprising lessons learned from the study of my own cases and from those of others is that the immediate operative mortality is remarkably small, and that the late operative mortality is large. In my ten cases I have had five operative deaths. Case I died eight hours after his operation, when he was suddenly taken ill with cardiac symptoms. At the autopsy in this case the patient was found to be suffering from a marked endocarditis; he also had a large aneurism of the thoracic aorta. Dr. Longcope thought that the cardiac condition alone was enough to account for the sudden death. There was peritonitis at the time of operation in this case, and even if the patient had not died of his cardiac condition I think that he might have died of the peritonitis. Case II died on the twenty-third day after operation, from infection due to necrosis of the bowel with fecal leakage. Case VI died on the sixth day after operation, apparently from septic intoxication. Case VIII died on the twenty-fifth day after operation, from a low grade infection and fecal fistula. Case X died on the fourteenth day from the same cause. It will be observed that there was but one prompt death after the

operation, and that from a cardiac condition, and that there were but two deaths within the first week. It is apparent, then, that the operative mortality is due to conditions which do not produce death under a number of days. In other words, the shock in spite of the prolonged operation, the age of the patient and even his bad condition, is not a significant factor in the mortality. The deaths result most frequently from necrosis of the bowel and leakage, and this necrosis in most instances is due not to a faulty method of suture but to the fact that the proximal portion of the bowel is in bad condition from either complete or incomplete obstruction. I am convinced that if the bowel was drained more frequently before the anastomosis was done the operative mortality would decrease considerably. The best operative results have been obtained where this primary drainage was employed. Moyni-han has collected 100 cases of resection for malignant disease of the colon from recent literature, the results of which are particularly interesting. In 68 cases a primary resection was done with 22 deaths, a mortality of 32.3 per cent.; in 12 Paul's operation (resection and drainage followed later by anastomosis) was done with one death, a mortality of 8.3 per cent.; in 17 colostomy was done first and resection later, with 3 deaths, 17.6 per cent.; in 3 ileocolostomy followed by excision, one death, 33.3 per cent. The ultimate results in these cases are given in answer to the last question.

7. Is the ultimate mortality due to too limited excision of the growth? I do not believe that it is. Most of the recur-rences that have taken place have not developed at the site of the previous resection. It is well known that glandular in-volvement in carcinoma of the colon takes place very late as compared with malignant disease elsewhere. In fact, ob-struction often occurs before any extensive glandular involve-ment has taken place. Again, we all realize the importance of going well above the seat of disease, and many times we are compelled to make wide excisions because of the poor cir-culation of the proximal portion or because of the inaccess-ibility of the colon near the growth. In cancer of the cecum the entire ascending colon should be removed, if for no other

reason than because an anastomosis between the ileum and transverse colon is better than an anastomosis between the ileum and the ascending colon. In cancer of the hepatic flexure the ascending colon and cæcum should be removed for the reason that ileocolostomy is of easier performance and produces better results than an anastomosis between the ascending and transverse colon. William J. Mayo reminds us that in 4 cases out of 5 the middle colic is the sole blood supply of the transverse colon, and unless these vessels are involved they should be preserved, else the whole transverse colon will become necrotic. In my series of 8 resections for cancer 3 recurred and one died one year after operation from recurrence without obstruction. Case IV died nearly two years after the excision of the cæcum for tuberculosis and 20 days after a second excision of the transverse colon for the same condition. Three patients are well at the present time. Case III, one of carcinoma, is well four years and two months after operation; Case VIII, one of carcinoma, is well fourteen months after operation, and Case IX, one of tuberculosis of the cæcum, is well four months after operation.

In close accord with my own results are those reported by Völcker (*Presse Médicale,* Oct. 10, 1908; " Year Book," Murphy, 1909) from the Heidelberg Clinic. He gives a study of 101 cases of cancer of large and small intestine, and concludes his paper with the statement that resection of the cancerous intestine is a very serious operation (50 per cent. mortality), but the patients surviving have a good chance of permanent cure (10 out of 17 survivors, 58.8 per cent.). In Moynihan's table of 100 cases he referred to the after history as given in 64 of the 73 cases which recovered from the operation: 17 were well at the end of six months; 15 at the end of one year; 15 at the end of two and a half years; 4 at the end of three years; 2 at the end of four years; one at the end of five years and 2 at the end of seven years. It will appear, then, that if we can improve our operative mortality our ultimate mortality will compare favorably with that following operations for carcinoma elsewhere.

LARGE PHAGEDENIC ULCER OF ABDOMEN.

BY WILLIAM HENRY LUCKETT, M.D.,

OF NEW YORK CITY.

WE use the word " phagedenic " in the title advisedly, for lack of a better term to describe a rapidly progressing ulcer of a gangrenous nature. Most text-books of to-day describe phagedenic ulcers in the past tense, so to speak, and put the condition in the same category as malignant syphilis, hospital gangrene, malignant œdema, etc., usually ending by saying that the condition is " chiefly found in tropical countries," " is rarely seen to-day," and is accompanied by "great pain and high fever," etc. Gangrene in some form or other is an ancient disease; it is mentioned in the papyrus Ebers, and both Hippocrates and Galen describe and recommend treatment for this condition. That the case herewith reported is nevertheless a rare one to-day, is substantiated by the fact that in a very large and active hospital and clinical service of fourteen years we do not recall seeing a similar case. This, together with the very unusual site and extraordinarily large size, engages special interest.

CASE.—A. K.; fifty-five years old; gardener by occupation; was admitted to my service at Harlem Hospital May 30, 1908, with the following history. Six days ago picked with finger nail a small pimple on skin of the lower part of abdomen on the left side. The following day noticed that a scab had formed over this point, which upon removal with finger nail disclosed a small ulcer. This ulcer has been rapidly increasing in size ever since, and is accompanied by intense itching and considerable pain. Denies gonorrhœa or syphilis.

Physical Examination.—Male adult, medium frame, poorly nourished, conscious, rational, but very irritable and excited and in great pain. Pupils react sluggishly; mucous membranes pale but moist; tongue coated; pharynx red; pulse fair size and force, tension above normal. Heart sounds of fair force; lungs clear.

liver, spleen, and kidneys normal; reflexes diminished; no bone pains or tenderness. Abdomen hard, somewhat retracted, and presents an ulcer with its centre on about the lower one-third of a line between the umbilicus and the anterior inferior spinous process of the ilium, oval in shape, longest diameter transversely, about 2 x 3 inches in size.

The centre of the ulcer presented a small round area of grayish, sluggish, low grade of granulations, about one inch in diameter. Surrounding this was a black ring of gangrenous skin, dry outside, moist and undermined and irregularly attached beneath, with small honey-combed sacculations of thick sloughy pus. The outer edge of this black ring was rather firmly attached to the adjacent skin, and although the demarcation was sharply defined, it would bleed if detachment were attempted. The circumferential adjacent skin was red, slightly raised and inflamed, but not undermined.

The ulcer was irrigated with hot potassium permanganate, 1 : 10,000 solution, and dressed with bichloride solution, but it continued to spread with, almost visible, frightfully rapid progress from day to day, always preceded by the ring of juxtaposed inflamed skin. Vigorous antispecific treatment exhibited without effect. Temperature continued high, pain great.

June 6, 1908, ulcer measured 4 x 8 inches; June 10, measured 5¼ x 10 inches. It was observed that the ulcer, while it remained more or less oval, spread transversely across the abdomen with considerably more rapidity than in an ascending or descending direction, and when the lower border of the ulcer reached the hair line of the pubes, its downward encroachment apparently was entirely checked; although it continued to spread upwards towards the umbilicus, it did so slowly. In other words, after the lower border of the ulcer was halted at the hair line, its extension or progress was upwards in an eccentric rather than concentric manner.

This upward and lateral extension of the ulcer cannot be explained on anatomical premises, for the extensive network and stems of the subcutaneous lymphatics of the abdominal wall below the umbilicus, the infra-umbilical region, pass downwards and forwards, parallel with the ilium, and empty into the inguinal nodes. So it will be seen that the more rapid spread of the ulcer, contrary to what might be reasonably expected, was against the

FIG. 1.

Phagedenic ulcer of abdominal wall.

FIG. 2.

Cicatrix after healing of ulcer.

lymphatic stream. It is indeed a curious point in this connection to note that the inguinal glands were never enlarged.

June 9, a blood count showed only a very moderate leucocytosis: W.B.C. 12,000, R.B.C. 4,200,000; differential: polymorphonuclears 78 per cent., lymphocytes 17 per cent., mononuclears 4 per cent., eosinophiles 1 per cent.

June 2, 1908, culture made from ulcer showed presence of *Staphylococcus aureus.* June 4, 1908. Dr. Humphreys, the hospital pathologist, reported diagnosis:

"*Phagedenic Ulcer of Abdominal Wall.*—Film preparations from purulent material at centre of slough show many pus cells, very many staphylococci, and a *few* long spindle-shaped bacilli, the latter showing numerous clear spaces in their protoplasm (spores?). Aërobic culture shows merely *Staphylococcus aureus,* the bacilli failing to grow. Similar preparations made from serosanguinous discharge at edges of ulcer show many more spindle bacilli, indicating that these are the primary infective agents. Anaërobic cultures taken and will be reported later. In my opinion, the infection probably belongs to the heterogeneous class, known as soil or dirt infection, to which belongs chancroid, phagedena, malignant œdema, etc. The organisms of this class in general are anaërobic spore bearers, inhabiting rich soil, etc. Owing to the difficulties of artificial cultivation, their specific characters are but little known. The staphylococci are probably of only secondary significance.

"The patient's occupation, gardener, and the location of ulcer, waist band, as well as his general arteriosclerotic condition and poor nutrition, seem to me to be of especial significance in this connection. No spirochæte to be demonstrated."

June 6, Dr. Humphreys reported: "Anaërobic culture overgrown by *Staphylococcus aureus.*"

The ulcer continued to spread, resisting all external and internal treatment administered, including some highly reputed, especially efficacious "special treatment for ulcers," until June 12, when it measured 5½ x 10½ inches, reaching as it did from near the anterior superior spinous process on the right across the abdomen to beyond the same on the left. Temperature 104°, pulse rapid, patient delirious and rapidly becoming seriously and profoundly asthenic.

June 13, it was decided to treat the case wholly on surgical

grounds and to totally ablate the ulcer by actual cauterization. Patient was etherized. The entire ulcer, including the skin beyond the inflamed ring, was thoroughly cauterized. The extent and magnitude of this procedure can be more fully grasped when we mention that we consumed the benzine of two freshly filled Paquelin thermocauteries in a period lasting fifty-five minutes. The cauterized surface was thoroughly swabbed with pure carbolic acid, which in turn was washed with alcohol, and a mild bichloride wet dressing applied.

Reaction after the operation was complete, nice clean granulations quickly replaced the eschar, cicatrization was rapid, patient began to improve in every way. Temperature normal in a few days after operation, and recovery was complete and rapid, without a single setback in the way of a reappearance of the former disease.

Fig. 1 shows ulcer nearly at its height of development; Fig. 2, ulcer healed. Note the small size of the contracting cicatrix.

Conclusions.—Procrastination and temporizing with ineffectual internal medication and external dressings came near to losing the patient. Such rapidly extending ulcers should at once be thoroughly ablated with the actual cautery.

INGUINAL HERNIA IN THE FEMALE.

BY WILLIAM B. COLEY, M.D.,

OF NEW YORK,

Attending Surgeon to the General Memorial Hospital; Associate Surgeon to the Hospital for Ruptured and Crippled.

INGUINAL hernia in the female constitutes a fairly large percentage of the total number of cases of hernia observed. At the Hospital for Ruptured and Crippled during the last twenty years, we have had 59,404 cases of inguinal hernia of which 9082 were in the female.

Championniere was the first to point out the excellent results that could be obtained by operation, and was one of the first to report a considerable number of cases.

With the help of Dr. D. H. M. Gillespie, I have made an analysis of 1692 cases of inguinal hernia in the female observed at the Hospital for Ruptured and Crippled, with the view of determining, as far as possible, at what period of life the hernia occurred. A special effort was made to ascertain in how many cases of hernia in adult life the hernia had existed in infancy or early childhood. These statistics show that it had so existed in 66 out of 1085 cases, or in 6 per cent. of the cases. It is probable that in a very considerable number of other cases the hernia had actually been present during infancy or childhood, but had been forgotten in the long interval that had elapsed.

TABLE I.—AGE OF PATIENTS AT TIME OF FIRST VISIT TO THE HOSPITAL.

	Single.	Double.	Total.
Up to 1 year of age	140	24	164
1 to 5 years of age	171	21	192
5 to 10 years of age	150	32	182
10 to 14 years of age	56	4	60
15 to 21 years of age	83	11	94
21 to 31 years of age	164	30	194
31 to 41 years of age	254	57	311
41 to 51 years of age	177	54	231
Over 51 years of age	185	70	255
Age not stated	6	3	9
	1386	306	1692

TABLE II.—CASES KNOWN TO HAVE HAD A HERNIA AT 14 YEARS OF AGE.

	Per cent.
34 of 94 between 15 and 21 years of age	36.1
19 of 194 between 21 and 31 years of age	9.8
8 of 311 between 31 and 41 years of age	2.5
2 of 231 between 41 and 51 years of age	.8
3 of 255 over 51 years of age	1.2
66 of 1085 cases	6.

ANATOMICAL VARIETIES—INDIRECT OR OBLIQUE HERNIA AND DIRECT HERNIA.

Some writers [1] state that direct hernia in the female is even more frequent than in the male. Our observations at the Hospital for Ruptured and Crippled are entirely at variance with this view. In making an estimate of the relative frequency of the two varieties one can consider only such cases as have been subjected to an operation, inasmuch as a positive diagnosis cannot be made without operation. Yet, the writers who believe that direct hernia in the female is comparatively frequent, pass their opinion upon a clinical diagnosis alone, unconfirmed by operation.

I have personally operated upon 353 cases of inguinal hernia in the female, of which 170 were adults and 183 children, and only 2 in this entire series were direct herniæ. Both of these cases occurred in adults; one was operated upon six weeks ago, a double inguinal hernia with the bladder in the sac on the right side. This gives a proportion of six-tenths of one per cent., or, if we count the adults alone, as there are practically no direct herniæ in children, it is 1.2 per cent. Comparing this with the cases of direct hernia in the male, I have operated upon 1776 cases of inguinal hernia in the male, of which 815 were adults; 961 children. Of these I have observed 50 cases of direct inguinal hernia, or about 3 per cent. If we consider adults alone, which is the only correct way, we have 5.5 per cent. in male and 1.2 per cent. in the female, which would make direct hernia in the male occur 5 times more common than in the female.

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[1] Escher, Deutsch. Zeit. f. Chir., 1899. B. iii, 53, H. 5.

Etiology.—I believe that inguinal hernia in the female, or at least all cases of oblique inguinal hernia in the female, are due to a persistence of the process of peritoneum known as the canal of Nuck, which corresponds almost exactly with the vaginal process of peritoneum in the male. That this process remains patent in many children long after birth, even into adult life, has been proven by a large number of investigators.

That the formation of the canal of Nuck is similar to the formation of the vaginal process of peritoneum in the male, is disputed by a number of writers, some, *e.g.*, Martin and Waldeyer, holding that this canal is a normal occurrence; others, like Duplay, believe it to be anomalous.

My own belief, based upon a careful study of 350 cases of inguinal hernia in the female, operated upon personally, is that the canal of Nuck is a normal development, which remains open in all cases in which a hernia subsequently develops as well as in many other cases that never have a hernia. This congenital process of peritoneum, by its failure to close I regard as the great and all-important cause of inguinal hernia in the female, as well as in the male, although in addition there are usually present various exciting causes, such as persistent crying in infancy and young children, straining of stool, heavy lifting, and coughing in adult life.

Karl Hemmerdinger in his inaugural dissertation (1902) speaks of the relation between congenital inguinal hernia and the descent of the testis or ovaries and the patency of the vaginal process of peritoneum in the male and the so-called Nuck's diverticulum in the female. He enters somewhat fully into the history of the development of the inguinal region, a knowledge of which is necessary in order to understand the mechanism of congenital inguinal herniæ.

Careful examination of an embryo eight weeks of age, shows at the lower end of the primitive kidney a second peritoneal fold running toward the inguinal region. This fold includes a rather coarse band of connective tissue, called the inguinal band, or cord of the primitive kidney. The same

plays an important rôle in the development of the male and female genital organs. In man it later becomes Hunter's gubernaculum; in woman, the round ligament.

The ovaries, the same as the testicles, undergo considerable change of location in their descent. In the third month of embryonic life they pass from the lumbar vertebra into the small pelvis. It is upon this descent of the ovaries that the above described inguinal band of the primitive kidney (which is also present in the female) is destined to act. During this process the inguinal band separates into three sections and enters into firm union with Müller's ducts at the point where they combine and form the sexual cord. The upper section, consisting of smooth muscle fibres, originates in the parovarium and is embedded in the hilus of the ovary. The continuation of this section is the ovarian ligament, and this, passing into the third and most highly developed section of the inguinal cord, forms the round ligament.

As to the origin of the canal of Nuck, Hemmerdinger believes that it is produced by the same causes that are responsible for the vaginal process in the male, even though there be apparent differences.

According to Bramann's observations, the vaginal process in the male originates in the following manner:

In the beginning of the seventh month of embryonic life a small indentation of the peritoneum occurs at the spot where the gubernaculum leaves the abdomen; at the same time the testicle passes into the scrotum. As the testis descends, the above-mentioned indentation becomes elongated. The same factor that causes the testicle to be drawn into the scrotum, elongates the small peritoneal sac lying before it. If this agent ceases to exert traction upon testicle and peritoneal sac, the latter's descent is arrested.

Thus, the peritoneal diverticulum is present before the testicle begins to traverse the abdominal walls. Hence, the vaginal process cannot be considered the result of a bulging of the peritoneum caused by the testicle. On the contrary, the testicle and vaginal process are united, and descend together.

The agent which draws downward the testicle and at the same time forms the processus vaginalis, has been called by Soulie, *un cordon cellulaire plein* (a plain, cellular cord). This cord may cause a diverticulum of the peritoneum and leave the testicle within the abdomen. Many of my cases prove the truth of this opinion.

In an analogous manner the same cord causes a protrusion of the peritoneum in the female, which is then called Nuck's diverticulum. Hence, both vaginal process and Nuck's diverticulum are due to the same cause in man and woman.

Herman Meyer of Zurich has made extensive investigations as to the relation of such peritoneal diverticuli to the development of inguinal hernia. He found in a new-born dog on either side of the abdominal wall an opening which led into a diverticulum 9 to 12 mm. in length; the same was situated outwardly and in front of the round ligament.

In the female fœtus of three to eight months, he found the same diverticulum six times, ranging in length from 1.75 to 10 mm., and in relatively the same position to the round ligament.

In new-born children and infants, Zuckerhandl found the canal of Nuck open in 37 per cent. of the cadavers examined: Féré in 9.2 per cent., sometimes on one side only, sometimes on both.

The reason many writers fail to recognize this canal is that the abdominal opening is difficult to find. Nobbe states that even in those cases in which the entrance to the vaginal process is relatively wide, the communication between the diverticulum and peritoneum is not always promptly found, as the cavity is covered by a fold of peritoneum and the transverse fascia. Only in the eighth cadaver examined (a girl three-fourths of a year old) was Nobbe able to recognize a canal of Nuck open on both sides. The diverticulum on the right side was 16 mm. in length and 3 mm. wide; the entrance opening was 8.5 mm. wide. On the left side the diverticulum was 17 mm. long; entrance opening 2.5 mm. and canal 3 mm.

According to Sachs the obliteration of the vaginal process
is due to granulation.

Féré found in one case in the entrance opening a protruding mass the size of a millet seed, which he interpreted as an exudate causing the obliteration. This obliteration may be complete or partial, which enables one to explain the different shapes of the hernial sac in external herniæ and hydroceles.

As regards the frequency of the patency of the vaginal process of peritoneum, Hemmerdinger states that this increases with advancing age. In the first ten to twenty days after birth obliteration proceeds very rapidly and comes to a completion in about 50 per cent. of the cases. From the twentieth to the thirtieth day after birth, the number of cases with total obliteration is much smaller, while there is a marked increase in the cases with an entirely open vaginal process.

Camper found in a series of 70 new-born babies, both vaginal processes open in 34; the right vaginal process in 14 and the left vaginal process in 8 cases.

Zuckerhandl examined 100 children during the first three months of life and found in 57 infants an unobliterated vaginal process on both sides in 20; on the right side in 12 and on the left side in 5 cases. In 188 children up to 3 years of age, examined by Féré, the vaginal process was found partially obliterated on both sides in 11, on the right side in 16 and on the left side in 14. In 18 obliteration had not taken place at all.

Of these 59 cases 32 were below 1 month of age, 6 from one to three months and only 10 were above six months.

From the above investigations it appears that the vaginal process of peritoneum becomes obliterated earlier on the left than on the right side, which may be explained by a later descent of the right testicle.

Similar conditions obtain as regards the canal of Nuck in the female. Hugo Sachs who examined 100 children within the first year states " The persistence of the canal of Nuck

is much rarer than that of the vaginal process in the male. In 75 per cent. of these children Nuck's diverticulum was obliterated at the moment of birth. Whenever it was not obliterated at that time, it showed very little inclination to become obliterated later."

Nobbe arrives at the following conclusions, based upon his own investigations as well as a study of the literature: (1) The canal of Nuck is found in about 8 to 10 per cent., while the vaginal process is found open in 30 to 40 per cent. (2) Obliteration occurs usually post partum, rarely ante partum. (3) The diverticulum is generally found open on both sides; more rarely it is found open on one side. If the canal does not become obliterated, it represents a preformed passageway for the herniæ.

Frequently the cavity of the vaginal process in the female becomes filled with a serous fluid (hydrocele muliebris).

Hemmerdinger reports the history of a case of hydrocele in the female observed at the Freiburg Clinic. Hydrocele in the female is not so exceedingly rare as was formerly believed. Wechselmann [2] in 1890 reported 62 cases, and in 1892 I published 15 cases observed at the Hospital for Ruptured and Crippled. In 353 adult cases of inguinal hernia in the female which I operated upon, hydrocele of the canal of Nuck was found in 11 cases.

As regards the etiology, I believe with Hemmerdinger, that hydrocele of the canal of Nuck is due simply to a failure of the diverticulum of Nuck, or the processus vaginalis, to completely close. The condition is really never more than an accumulation of fluid in the lower end of an actual or potential hernial sac.

E. Scott Carmichael of Edinburgh, has contributed some valuable facts upon inguinal hernia in the female (Trans. of the Medico-Chir. Soc. of Edinburgh, 1905-6, p. 226). His conclusions are based upon a statistical study of 727 radical operations in both sexes, treated by Harold Stiles and [?]

² Arch. f. klin. Chir., 1890, 40, 575.

himself. In this series of cases 5 to 10 per cent. occurred in the female. In 184 radical cures performed by Carmichael in children, 23 were females. Of the 729 radical operations in both sexes, 76 were in girls, giving a percentage of 10. 21 were under one year of age; 21 were under five years of age, and 34 were over five years of age. 39 were on the right, 24 on the left side, and 13 double.

A study of the contents of the sac is of great interest. The following contents were either found in the sac or could be pulled down into the sac in 28 cases:

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Fallopian tube and ovary....................................  17
Fallopian tube alone........................................   5
Small intestine ............................................   2
Omentum ....................................................   2
Cæcum and ovary and Fallopian tube.........................   1
Vermiform appendix and ovary and Fallopian tube......   1
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In two cases the sac was tuberculous.

Carmichael states that it is suggestive that the persistence of the so-called canal of Nuck should be associated in such a large percentage of cases (over 30 per cent.) with malposition of the ovary and Fallopian tubes. In the young child the position of the ovaries and tube shows great variation. Sometimes the ovary lies longitudinally along the lumbar vertebræ, resting on the psoas muscle; again, it may be found on the false pelvis or in the cavity of the true pelvis. Carmichael believes that the action of the gubernaculum or inguinal ligament may be in some way responsible for the position of the ovary. He does not believe that it is possible to explain the presence of the ovary and Fallopian tube in 24 cases out of 28 by simple mechanical causes, but thinks that in some way it is associated with the development of the inguinal ligament. That the formation of the canal of Nuck is analogous to the processus vaginalis in the male, Carmichael believes to be doubtful.

He regards the canal of Nuck an abnormal protrusion, associated with the development of the inguinal ligament. He points out the fact that the ovary and tube do not lie

free in the sac in the same sense as a loop of intestine and omentum, but are intimately associated with its wall, the broad ligament or mesosalpinx springing directly from the posterior aspect of the sac. The relation of the ovary to the sac very closely resembles that found between the sac and the cæcum and sigmoid.

Lockwood regards ovarian hernia due to abnormal length of the mesovarium or mesosalpinx. Carmichael's series of cases does not support this view. His cases show a large percentage of inguinal hernia in the female to be bilateral. In babies under one year, of 21 cases 8 were double; of 21 under five years, 2 were double; of 34 over five years, 3 were double.

A much greater frequency of ovarian hernia in the very young is also shown by Carmichael's statistic:

In 21 under one year, ovary and tube were found in 13 cases; in 21 under five years, ovary and tube were found in 7 cases; in 34 over five years, ovary and tube were found in 2 cases.

The very large proportion of ovarian herniæ shown by Carmichael's statistic is probably due to the fact that 21 out of 76 patients were individuals under the age of one year; 21 others were under five years.

Practically all of my cases were over four years of age, and 170 of them were in adults. While I have seen a considerable number of cases in infants and young girls in which I was able to palpate the ovary, in only a very small proportion of the older patients was the ovary found at operation.

Bladder hernia in my own experience is an extremely rare condition in the female. My series of 350 cases shows only two examples of bladder hernia, both of the paraperitoneal variety. In both of these cases the hernia was of the direct type.

Eggenberger (*Deutsche Zeit. f. Chir.*, Oct., 1908) whose paper upon bladder hernia gives the most recent and most complete statistics of the subject, was able to add 110 cases to the 182 cases twelve years previously collected by Brunner. The sex is given in 241 cases, 168 of which were males, 73

females. While Brenneisen gives the proportion of male to female cases as 3 : 1, Eggenberger's personal statistic shows a ratio of 3 males to 2 females. Of the male cases, 55 were inguinal, 5 femoral hernia; of the female cases 15 were inguinal, 23 femoral hernia.

I have personally never seen a cystocele in a femoral hernia. One of my cases, a large irreducible inguinal hernia, contained an incarcerated appendix with considerable fluid in the sac.

Tumors of the hernial sac, while found in both male and female, are much more common in the female, taking the form of a cyst, or the so-called hydrocele of the canal of Nuck.

Solid tumors of the inguinal canal are extremely rare. Kepler (*Boston Med. and Surg. Jour.*, Aug. 20, 1908) reports a case of dermoid cyst of the canal of Nuck and gives a very careful review of the literature. His case occurred in an unmarried woman, 26 years of age, who had worn a truss since childhood for a supposed right inguinal hernia. The hernia became apparently cured, but re-appeared two years prior to the date of the operation. The symptoms were strongly suggestive of catarrhal appendicitis with recurrent attacks. Examination showed a sausage-shaped painless swelling in the right inguinal canal which occasionally disappeared for a short time. This had been irreducible for about a year. Operation showed a mass occupying the canal of Nuck which could be displaced upwards about two inches. On opening the tumor there was an escape of much thick cheese matter with hair. Pathological examination was made by Dr. Leary of Tufts Medical College and showed it to be a cyst of the canal of Nuck. Microscopical examination proved it to be dermoid in character. Kepler's careful review of the literature showed this to be apparently a unique case.

I have seen one case of Fallopian tube in the sac of a femoral hernia. It was irreducible and very adherent. The patient was aged 29 years and the operation was performed February 4, 1909.

I have operated upon one case of multiple cyst of the canal of Nuck February 5, 1909. The patient was 41 years of age and had had a swelling of several years' duration in the right inguinal region; it had never been reducible. Operation disclosed four cysts of various sizes not communicating with one another, the uppermost one occupying the inguinal canal, separated from the abdominal cavity by a thin layer of peritoneum. The size and anatomical situation of the cysts are shown (Fig. 1).

Unusual Cases of Inguinal Hernia in the Female.—Inguinal hernia of tube and ovary, one case aged 12 years; one case aged 6 years; one case aged 3 years; one case aged 48 years. Strangulated hernia of appendix with large amount of exudate, one case, aged 35 years (Fig. 2). Double direct hernia with the bladder on the right side, one case, aged 55.

Interstitial Hernia (Case I).—*Strangulated interstitial hernia the size of a cocoanut, containing cæcum and ascending colon.* This case is so extremely rare, that it merits a detailed report.

Mrs. S., 40 years old, was admitted to the Hospital for Ruptured and Crippled in the afternoon of May 11, 1908, and operated upon immediately. She gave no history of ever having had a hernia, but three days before began to have pain and discomfort in the right lower abdomen, accompanied by almost complete obstipation, some nausea. The symptoms became gradually more severe. The nausea increased and was followed by slight vomiting. Before she was admitted to the hospital she had been examined by the house surgeon, who found a tumor in the right lower abdomen which was tender on pressure and irreducible. I saw her about an hour after admission; the pulse was 120, temperature 99.5°. While her general condition could not be called good, she did not show very marked prostration. She was fairly stout, with considerable adipose tissue in her abdominal wall.

Physical examination showed practically nothing abnormal on inspection. On palpation a tumor the size of a grape fruit or two fists could be made out in the right iliac region, extending up nearly to the level of the umbilicus and downward as far as the inguinal region. There was, however, no tumor either in

the inguinal or femoral canals. On coughing, a protrusion could be felt apparently coming through the internal ring and extending partly into the inguinal canal. The whole tumor seemed to be situated beneath the external oblique aponeurosis; it was tympanitic on percussion, resilient on palpation, symmetrical in outline, and quite irreducible. I made a diagnosis of strangulated interstitial hernia, from the anatomical position of the tumor, and believed the contents of the hernial sac to be cæcum, for, had the small intestine been strangulated for such a length of time, the symptoms would have been much more acute.

A long, oblique incision was made over the tumor. On cutting through the skin and superficial fascia, I came down upon a greatly distended external oblique aponeurosis, which was then incised. It disclosed a very large hernial sac which lay on the outer side, beneath the external oblique aponeurosis and on the inner side was situated partly under the external and partly under the external and internal oblique both and the transversalis fascia beneath, making it practically a properitoneal hernia. This sac was found to contain several ounces of slightly cloudy exudate, the whole cæcum and part of the ascending colon which were dark-colored but with no areas of necrosis. Under hot towels circulation became sufficiently good to warrant their return into the abdomen. The patient made an uneventful recovery.

The strangulation was evidently caused by a strong fascial ring, apparently the internal ring and the intestine, after emerging from the internal ring, extended upwards instead of downwards until it had occupied the position already described (Figs. 3 and 5).

It seems to me the most probable explanation of the development of this hernia is, to regard the sac as a diverticulum of congenital origin.

There is another explanation which I formerly held to be the true one i.e., to regard the sac as an acquired sac which. had gradually taken the position found at operation because it had met with some obstruction in its downward course, and it simply followed the line of least resistance. This was the view held by Macready.

Interstitial Hernia in the Female is an extremely rare oc-

Fig. 1.
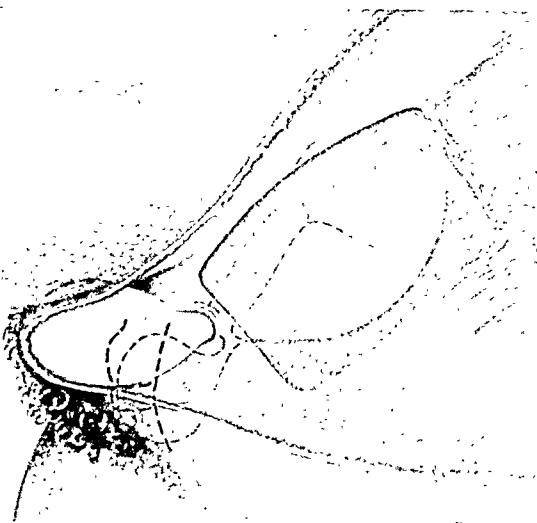
Multiple cysts of canal of Nuck.

Fig. 2.
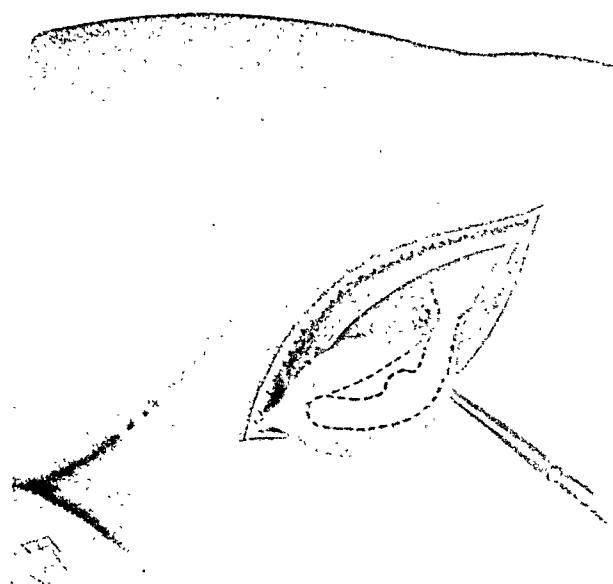
Incarcerated hernia of the appendix, with sac distended with bloody fluid.

FIG. 4.

Strangulated interstitial hernia in the female.

Interstitial hernia in the female, associated with hydrocele in the canal of Nuck. (Bull and Coley.)
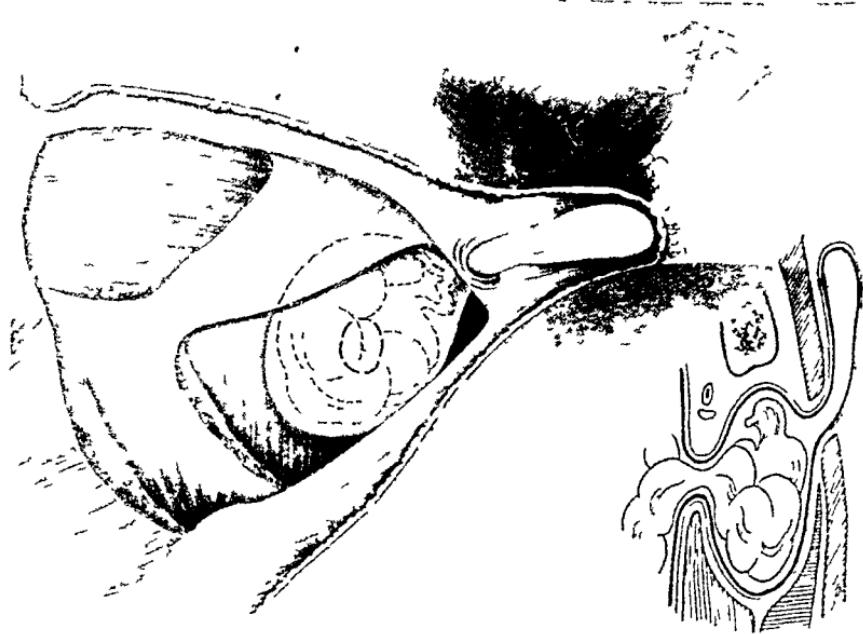
currence and very few cases have thus far been reported. The first in this country was, I believe, the one reported by Dr. Bull and myself, in the *New York Medical Journal* in 1890. In this case the hernia was associated with a large hydrocele of the canal of Nuck which we at that time regarded as furnishing the mechanical obstruction which caused the hernial sac to proceed upwards beneath the aponeurosis of the external oblique (Fig. 4).

CASE II.—*Properitoneal Hernia in the Female.*—A. M., aged 49, with a history of having had more or less discomfort in

FIG 5.
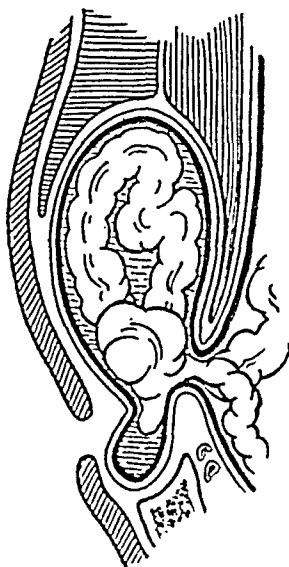
Interstitial hernia in the female. (Coley.)

the right iliac region for a number of years; had never worn a truss. In the middle of February, 1909, she came to the Hospital for Ruptured and Crippled with a swelling about the size of a goose egg or small orange in right iliac and upper inguinal region. The swelling had appeared suddenly ten hours previous to her coming to the hospital, and was accompanied by a good deal of colicky pain, but no vomiting. The swelling was reduced by the house officer without an anæsthetic and the patient returned home. Two weeks later she was admitted to the Hospital for Ruptured and Crippled under the diagnosis of inguinal hernia. although one of the surgeons who saw her in the out-patient

department regarded it as femoral hernia. The hernia was not down at the time of examination.

I operated upon the patient March 5, 1909, at the Hospital for Ruptured and Crippled. The usual Bassini incision was made over the inguinal canal; but on cutting down, I could find no enlargement of the external ring, in fact, I could hardly find an opening sufficiently large to introduce a director. This fact, together with the discovery of a mass of fat the size of an English walnut, in the femoral region, made me suspect an error in diagnosis and to think that we had really to deal with a femoral rather than an inguinal hernia. Careful dissection, however, of the mass of fat failed to disclose any sac whatever in the femoral canal. I thereupon opened the aponeurosis of the external oblique over the inguinal canal nearly to the level of the anterior superior spine and downwards through the external ring, which was not at all enlarged. Directly under the aponeurosis at the lower point, near the external ring, I found what proved to be a large hernial sac which extended upwards beneath the internal oblique muscle and the aponeurosis for a distance of at least 3 inches. On opening the sac it was found empty. The neck of the sac, about one inch in diameter, was situated at about the site of the normal internal ring. The anatomical situation of the sac between the internal oblique and transversalis fascia is well shown by the accompanying illustration (Fig. 6). The sac was removed, the opening in the peritoneum closed and the sheath of the rectus muscle was cut and reflected and, with the internal oblique, sutured to Poupart's ligament. The patient made an uninterrupted recovery.

The only other case of true properitoneal hernia in the female which I have been able to find in the literature in addition to the two cases in Göbell's collection, is the case reported by Sultan, in his paper on " The Mechanism of the Retrograde Incarceration of the Gut " (*Centralbl. f. Chir.,* Dec. 28, 1907), with three illustrations. In this case, however, no operation was performed. The condition was found at autopsy.

The patient, a woman 53 years of age, entered the hospital on September 19, 1907, with symptoms of perforative peritonitis. She was in a moribund condition at the time of entrance, so that it was impossible

to operate. She died one and one-half hours later. Autopsy showed a hernia in the right iliac region between peritoneum and fascia, *i.e.*, an inguinoproperitoneal hernia. The sac contained two loops of small intestine and a mass of omentum. The hernial orifice lay in the internal inguinal ring, yet there was no constriction at this point. The strangulated loop of bowel was situated in the abdomen proper, showing the rare condition of retrograde incarceration.

Cumston (ANNALS OF SURGERY, 1905, p. 427) in a paper upon Interstitial Hernia, emphasizes the fact that the condition is extremely rare in the female. Of the 69 cases of inguinoproperitoneal hernia collected by Göbell only 2 were in the female.

Our knowledge of interstitial hernia is based chiefly upon the exhaustive paper of Göbell (*Deutsche Zeitschr. f. Chir.,* Bd. lvi). Of 115 cases collected by Göbell, only 4 occurred in women.

Cumston states that in the 11 cases collected by him up to 1900, not a single one was found in the female. He reports a personal case occurring in a girl of nine. Shortly before operation she had symptoms which were supposed to point toward appendicitis, which disappeared on confinement to bed. The symptoms were believed by Cumston to point toward a partial strangulation, which was relieved by horizontal position. The operation disclosed a bilocular sac, the lower end extending into the labium, the upper occupying a position between the internal and external oblique muscles.

Auvray (*Gazette,* June 10, 1901) reported a case of interstitial hernia in the female observed in 1900, and this case was believed by Cumston to be the first recorded case. He had, however, overlooked the case operated upon by Dr. Bull in 1890 and published in detail by Bull and Coley (Fig. 4).

Another case was operated upon by Helferich and reported the following year by Müller. Fredet reported a case in 1901; two others were reported in the same year by Brunco, in his thesis.

Intraparietal Hernia.—A most interesting case of interstitial hernia observed at Helferich's clinic was reported by Müller in his inaugural dissertation (1901).

The patient, who claimed to have never had a hernia, suddenly noticed a tumor in the inguinal region after lifting a child. One month later the hernia became irreducible and the patient entered the clinic. The diagnosis of interparietal hernia was made and immediate operation advised. The latter revealed half of the sac in the labium major, the other half between the external and internal oblique muscle, external to the inguinal canal. Isolation of the interparietal part of the sac was easily accomplished, while that of the portion in the labium major caused considerable difficulty.

Müller states that outside of the above, only 11 such cases have been observed—all males; 5 of these were reducible; 5 incarcerated; 1 was found at autopsy; and all 11 were crytorchids. Müller considers the case reported by him of special interest, as he believed it represented the first well-authenticated case of a hernia situated between the external and internal oblique in a woman, and also the first case that was irreducible. He had overlooked the case of Bull and Coley published ten years before. He states that the narrowness of the inguinal canal in the female and its greater length as compared to that in the male, account for the relative rarity of inguinal hernia in the female.

According to Jobert, the right inguinal canal in both sexes is wider than the left, which explains the greater frequency of inguinal hernia on the right side, at least in the female. Both of my cases occurred on the right side, as also did Dr. Bull's case.

Müller states that inguinal hernia of congenital origin is more frequently observed on the right than on the left side, and he believes that in the case reported the hernia was probably congenital, although the patient was not aware of its presence. For, only the pre-existence of a hernial sac, as shown by the investigations of Roser, Linhart and English, renders the sudden appearance of a hernia possible. This is also my opinion, and the conditions found in both of my cases strongly confirm this view. In one case the lower loculus of the sac passed beyond an external ring too small to permit the passage of hernial contents.

The first exhaustive description of an interstitial hernia

was published by Goyrand in 1836. Göbell, in his work "On Interparietal Inguinal Hernia" (*Deutsche Zeitschr. f. Chir.,* lvi Bd.) gave a critical review of the literature of the subject and suggested a nomenclature which, Müller thinks, well worthy of general adoption. He distinguished complete and incomplete hernia, subdividing these into:

1. Inguinoproperitoneal hernia.
2. Inguinointerstitial hernia.
3. Inguinosuperficial hernia.

These might be further divided into monocular and bilocular interparietal herniæ.

The monocular herniæ are usually congenital, while the bilocular may be either congenital or acquired.

The principal etiological factors in the development of these herniæ Müller believes to be (1) The anatomical structure of the canal; (2) An impediment (either mechanical or anatomical) to the passage of the hernial contents.

Inguinoproperitoneal hernia had been observed 69 times up to the writing of Müller's dissertation; 67 times in men and only twice in women. Only 7 were reducible; the remainder showed symptoms of incarceration, and in the majority of cases the hernia was not discovered until the time of operation.

The hernia was found on the right side in 37 cases; on the left, in 23; in 9 the side was not stated. Sixty of these herniæ were bilocular.

Of inguinointerstitial hernia, Müller found 200 cases reported. Of these 162 occurred in men, 38 in women. 129 and 34 of these respectively, are included in Macready's statistics of reducible herniæ. They were not operated upon nor was autopsy performed; hence, all anatomical data are absent. In the remaining cases the histories are sufficiently explicit to enable one to determine in which interstices of the muscles the sac was found. Most frequently it was noticed between the external and internal oblique, and of this variety, as has been stated before, only 12 cases (including Müller's) are known. My own case makes 13.

The rarest cases of inguino-interstitial hernia are those in which the sac is embedded between the fibres of the internal oblique muscle, or between internal oblique and transversalis fascia. My second case was of this variety.

Moynihan even claims that such herniæ have never been seen. It must be stated, however, that Goyrand, Berger and Venturoli have seen fibres of the internal oblique muscle anteriorly and posteriorly to the sac, in fact, Goyrand considers this a characteristic of this variety of hernia; in Berger's case the hernial sac was found within the thickness of the internal oblique, and Venturoli was obliged to sever the fibres of the internal oblique in order to reach the sac.

As interparietal herniæ are very apt to become incarcerated, radical operation is the best treatment.

Brunco (Inaugural Dissertation, 1904) reports two cases of left interstitial hernia in the female, operated upon by Graser of Erlangen.

CASE I.—A widow, 66 years of age, with a history of a small lump in inguinal region for three years, with rapid increase in size in last year. The hernia was found between the external and internal oblique muscles.

CASE II.—A woman, 46 years of age, with a history of severe attacks of vomiting during the past sixteen years, recurring at intervals of a few weeks to three months. Medical treatment was employed without relief. In the left groin a protrusion the size of the fist was found, extending from the external ring upwards towards the anterior spine of the ilium. On splitting the aponeurosis a hernial sac was found lying between the external and internal oblique muscle and containing a loop of inflated small intestine.

Brunco states that radical operation should be performed in all cases of interstitial hernia, since the prognosis in the cases not operated upon is unfavorable, far more so than in ordinary inguinal hernia, for the reason that they are very apt to become incarcerated. One half of Göbell's cases were incarcerated.

Method of Treatment of Inguinal Hernia in the Female.— In a considerable number of cases of hernia in the female in infancy and early childhood, the hernia is either cured by the wearing of a truss, or, in some cases, even spontaneously.

Fig. 6.

Properitoneal hernia (inguinal) in the female.

Fig. 7.

Labial hernia

Fig. 9.

Inguinal hernia in female, showing sac dissected from round ligament.

Fig. 8.

Modified Bassini method, without transplanting cord. Suture of the internal oblique to Poupart's ligament etc. (Bell and Coley.) Note last stitch placed to include reflected aponeur-

For this reason, I do not go so far as Stiles and Carmichael of Edinburgh and some of the French surgeons, notably Broca, in advising operation during this period of early infancy. The statement which I have already referred to, that our statistics at the Hospital for Ruptured and Crippled show 6 per cent. of adult cases of inguinal hernia in the female in which the hernia existed during infancy and childhood, although short of the actual truth, still show that a large number of the cases that occur in early life, are cured without operation, for we know that inguinal hernia in the female is far more frequent during infancy than at any other period of life. Personally, I seldom advise operation in children under the age of three to four years; first, because I prefer to give the child the chance of a mechanical cure, and, second, because there is little risk from strangulation at this age. I have never seen a case of strangulation in inguinal hernia in the female under the age of fourteen. In addition, should strangulation occur, the mortality of operation is very small. In 20 cases of strangulated hernia in children at the Hospital for Ruptured and Crippled, we have not had a single death. After the age of three to four years, we believe it wise to operate on practically all cases. The operation is simple, free from risk, and the child need not be confined to the bed more than 10 days or two weeks. Adults I usually keep in bed for two weeks and allow them to go home at the end of two and a half weeks.

Method of Operation.—The method of operation which I have employed has been the same in the entire series of cases, and consists in an operation practically identical with the modified Bassini operation which Dr. Bull and myself introduced at the Hospital for Ruptured and Crippled in 1892. (See ANNALS OF SURGERY, 1895, '97 and '98.) The only variation from the typical Bassini operation is that the cord is not transplanted, but allowed to emerge at the lower angle of the wound. In the female the round ligament is treated the same way as the cord in the male, in that it is left undisturbed at the bottom of the wound, the internal oblique

being sutured to Poupart's ligament; the aponeurosis is then closed and last of all, the skin as shown in Figures 8 and 9.

The transplantation of the round ligament as proposed and carried out by Howard Kelly ("Operative Gynæcology") at Johns Hopkins, is entirely unnecessary and has not given as good results as when it has been allowed to remain undisturbed.

Some surgeons, among them Championniere, have removed the round ligament along with the sac, for the reason that the dissection of the sac from the ligament is much more difficult than the dissection of the sac from the cord in the male.

However, with a little care, and going about the dissection in the right way, one can always separate the sac from the round ligament, and I have always done this, believing it unwise to unnecessarily sacrifice the ligament. The sac is then dissected high up beyond the neck and closed by transfixion with a catgut ligature, the wound being then closed in the way I have described in the modified Bassini operation (the Bassini method without the transplantation of the cord.

Results.—In this series of 353 cases, there has been no death and but two relapses, and the large majority of cases have been traced to final result. One of the relapses occurred in a woman 35 years old, two years after operation, and was brought on by very heavy lifting which, at the same time, caused a hernia on the sound side. The second relapse was anticipated, for the reason that the operation was performed in a woman seven months pregnant, 35 years of age, with a very large strangulated inguinal hernia the size of two fists. The sac and outlying tissues, including fascia and muscles, were infiltrated with exudate and the gut was in a precarious condition. The operation was performed as rapidly as possible and the wound closed with drainage. Extensive suppuration followed, and although the patient was delivered at full term of a healthy child, the wound had not become firm enough to stand the severe strain of childbirth, and relapse occurred shortly afterward.

BIBLIOGRAPHY.

Escher: Deutsche Zeitschr. f. Chir., 1899, Bd. liii, H. 5.

Göbell: Deutsche Zeitschr. f. Chir., Bd. lvi, p. 1.

Müller: Inaugural Dissertation, 1901, Kiel.

Brunco: Inaugural Dissertation, 1904, Erlangen.

Sultan: Centralbl. f. Chir., Dec. 28, 1907.

Hemmerdinger: Inaugural Dissertation, 1902, Freiburg.

Carmichael: Trans. Medico-Chirurg. Soc., Edinburg, 1905-6, 226.

Winlicher: "Zur Casuistik eingeklemmter Brüche," Wiener Med. Blätter, 1882, No. 12 and 13.

Hildebrand: "Uber eingeklemmte Brüche," Inaugural Dissertation, Berlin, 1879.

Lange: "Hernia inguino-properitonalis Incarcerata gangrenosis," Med. Rec., 1881, xx, 101.

Lejars: Rev. de Chir., 1899, vol. ii, p. 219.

Von Maydl: "Die Lehre von Unterleibsbrücken," Wien, 1898.

Macready: Treatise on Ruptures, 1893.

Berger: Traite de Chirurgie, 1901 (Duplay et Reclus).

Bloodgood: Johns Hopkins Reports, vol. vii, 1900.

Cumston: ANNALS OF SURGERY, 1905, p. 427.

Bull and Coley: New York Medical Journal, 1890.

Coley: "Inguinal Hernia in the Female." ANNALS OF SURGERY, 1898.

Coley: Chapter on Hernia, Keen's Surgery, 1909, vol. iv.

SURGICAL ASPECTS OF CHRONIC HYPERTROPHIC ARTHRITIS.

BY GEORGE P. MULLER, M.D.,

OF PHILADELPHIA.

Associate in Surgery in the University of Pennsylvania; Assistant Surgeon to the [University Hospital; Consulting Surgeon to the Chester County Hospital.

THE study of chronic disease of the joints has become enhanced in interest in recent years by the special attention given to those forms generally called rheumatoid arthritis or arthritis deformans. A perusal of the recent literature gives one the impression that the study of this disease is of comparatively recent date and that heretofore all chronic joint disease, not of distinctly infectious origin, was generally classed under the heading of chronic rheumatism. But although the use of the X-ray has made many of the symptoms and signs of the bony lesions more easily comprehended we have made but little advance in the study of the etiology of the affection nor have we learned to check the deformities with certainty. We have simply supplied new names for old conditions and the writings of Charcot, Garrod, Heberden, etc., are nearly as accurate as more recent and therefore better known writers.

The great variety of the lesions, the lack of unifomity in the symptoms, and especially the uncertainty of the etiologic factors are responsible for the existing confusion in nomenclature, there being almost as many classifications as there are monographs on the subject. Broadly, chronic joint disease can be divided into those of infectious origin and those which are supposedly non-infectious; the latter embrace those caused by a distinct trauma, by some dyscrasia such as hæmophilia, by some purely functional cause, and those types associated with anatomic change and deformity.

A deforming arthritis may arise as an apparent primary affection, may be secondary (reactive) to disturbed nutrition

of the joint, or may be neuropathic, as in tabes or syringo-myelia. By a process of exclusion we may arrive at a classification embracing a variety of chronic joint affections which at first seems all sufficient to comprise the clinical material. Actually, in a given series of cases, we may see similar lesions and symptoms due in one patient to a trauma, in another to a well-established previous attack of acute articular rheumatism, in a third to some metabolic disorder, and in a fourth without discoverable cause. An attempt was made a few years ago in England to study rheumatoid arthritis by means of a small hospital where patients could be received for a short time and studied. Bulletins were issued under the leadership of Dr. T. S. P. Strangeways and valuable information gained, but the work was discontinued for lack of funds.

Hypertrophic arthritis,. sometimes called osteo-arthritis, is that form of chronic joint disease characterized by a hyper-trophy of the cartilage and bone and the formation of osseous spurs at the margins of the articular cartilages or at the attach-ments of the ligaments. Males of about 45 years of age are most liable to be attacked, and cold, exposure, strains, and various forms of trauma are considered as factors in the etiology. Rimann in a recent paper found 25 knee-joints affected in 100 post-mortem subjects, the disease being in various stages, and in 17 the cause of death was arterio-sclerosis in some of its manifestations, in 4 tuberculosis, and in 4 carcinoma. As to the exact cause nothing but specula-tion has so far been indulged in, the most generally accepted theory being that an autoinfection from defective metabolism causes a fibrous metaplasia of the cartilage, capsule, and liga-ments, a thickening from osteosclerosis of the ends of the bones and a proliferation of the bony tissue from the diseased cartilage which is not subjected to pressure.

The cartilage and bone seem to bear the brunt of the dis-ease, as the synovial membrane is not much thickened; there is little villous hypertrophy nor is there much fluid present unless there has been a recent sprain. The cartilage is thick-ened, glistening, and dense in appearance and at its margin,

i.e., at the junction with the synovial membrane, is congested, often bluish and elevated into ridges and nodules. The latter are most apt to occur at the lateral margins of the knee-joint, along the epiphyseal line and superior lip of the acetabulum in the hip and extending into the lateral ligaments of the fingers, in which case the term Heberden's nodes is often used. If erosion of the cartilage occurs it takes place at points where pressure is brought to bear and is of the nature of decubitus erosions. Detached pieces of cartilage are but rarely observed. The bone is thickened and the cartilaginous masses referred to become ossified and form the characteristic spurs. If erosion of the cartilage takes place the bone may become eburnated, with a polished surface and usually white in appearance, although discoloration with blood pigment may give a reddish color. Ankylosis does not appear to supervene, as a rule, probably from the lack of deposited fibrin. Microscopically the cartilage is thickened and fibrous, the bony trabeculæ are large and thick but there is no evidence of endarteritis nor of a cellular infiltration. Without digressing further I wish to present the following case observed on the service of Dr. C. H. Frazier in the Hospital of the University of Pennsylvania and to whom I am indebted for the privilege of operating upon the patient:

C. W. B. (No. 914); age 69; male. Was first admitted to the University Hospital March 29, 1905, with the following history: Has always been exposed to cold and wet, first as a seaman and later as a locomotive engineer. Had several attacks of gonorrhœa and twenty-five years ago contracted syphilis. Five years ago (August 10, 1900) an enlarged bursa was removed by Dr. Frazier from his right popliteal space and he dates the present trouble from about the same time, although not to the effects of the operation nor to the bursa itself. He suffered from severe pain in the knee when the right leg was extended which, radiating up the thigh, was increased by use. The leg never became locked in flexion or extension. It was believed that he was suffering from some hypertrophy of the synovial membrane with "pinching" of the fringes. On March 30, 1905, Dr. Frazier explored the joint and found the lipping characteristic of a hypertrophic arthritis without displacement of the semilunar cartilages. He

was discharged April 12, 1905, with the instruction to rest the knee as much as possible and to wear an elastic support. He returned several times during the next three years but was merely examined and various forms of local applications prescribed, including the use of the baking apparatus. He was able to work as an engineer until September, 1907, without much pain or serious inconvenience, although he noted that the joint was increasing in size. From this time on the knee began to pain considerably and he was forced to give up working, but could get around with the aid of a cane. He returned to the University Hospital April 11, 1908, and was anxious to have an amputation done if the pain could not be otherwise relieved. The right knee was visibly enlarged but was not very tender nor were there any signs of effusion, the hypertrophy to the touch and to the X-ray being due to bony overgrowth. His joints were generally prominent and some of the metatarsophalangeal joints were also the seat of bony hypertrophy, but they caused no annoyance. The feet were flat and the legs showed varicose veins. He had no prostatic, cardiac, or renal troubles. On April 13, 1908, I opened the joint by a transverse elliptical incision below the patella which disclosed the typical appearance of the disease. The bony outgrowths not only involved the edges of the joint but extended upwards on the anterior surface of the femur for 2 inches. The posterior surface of the patella was similarly involved. The semilunar cartilages were small and narrow, the synovia thickened and slightly congested, there was merely a glairy fluid in the joint. and the internal articulating surfaces showed sufficient erosion of the cartilage to bare the bone. It was thus seen that the creak- ing and pain were evidently produced by the grinding of the bared bony surfaces and the enlargement and thickening were due to the bony outgrowths. Removal of the latter did not seem to offer any prospect of relief from pain and accordingly I per- formed a formal excision of the knee-joint. As an arthroplasty was also not deemed advisable the femur was sawed so that its diameter would approximate that of the tibia and allow of fixa- tion in a slightly flexed position. The exostoses were chiselled from the shaft of the femur and from the under surface of the patella. The lateral ligaments were sutured and the patella drilled and fastened over the line of excision by catgut sutures. The skin was closed without drainage and the limb placed on a posterior splint. Healing by first intention resulted and a week

after operation a plaster-of-Paris cast was applied. The patient was discharged June 10, 1908, on crutches with apparent bony union. He returned, however, on July 28, 1908, with pain in the knee and a slight degree of motion, the pain being sufficient to prevent him from working. An X-ray picture showed a distinct line between the ends of the bones and after a week in bed I again operated (August 8, 1908) upon the limb. After dividing the hamstring tendons, a transverse incision was made over the line of excision and the bones pried apart with a chisel. The ends were well curetted and a groove chiselled on either side of the femur one inch above the line of union and from which the bones were fastened together by two silvered steel screws two inches long. The grooves had the effect of countersinking the heads of the screws and enabled them to be driven almost downwards. The wound was again closed without drainage and the leg placed immediately in a cast. It once more healed perfectly and on October 22, 1908, the patient was discharged with bony union, the leg being protected by a light steel brace at the knee owing to the spring of the long lever from hip to ankle. I heard from him in December and he was walking on the limb with but little disability and no pain.*

The treatment of the various manifestations of hypertrophic arthritis will seldom be surgical. Pain, swelling, stiffness, and deformity are the symptoms calling for relief, and an earnest attempt should be made to determine the etiology of the case. Any form of chronic infection, whether from the tonsil, intestine, prostate, etc., must be eradicated, the diet carefully regulated, general massage ordered, and rest of the limb enjoined, preferably by extension if the hip or knee is involved or affected. In hypertrophic arthritis it is obvious that incision and drainage of infected fluid is never indicated, as the disease has never been shown to be due to the presence of bacteria in the joint, nor is there any effusion. The swelling is essentially due to thickening of the bones and the presence of bony outgrowths upon the tibia and femur at the edge of

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*After reporting this case to the Academy of Surgery I saw this patient in June, 1909. He had discarded his brace, had been drinking heavily and was in wretched physical condition. The knee pained him considerably at the site of the screws. I advised their removal but he has not returned.

their articular cartilages and which in most cases does not require operative interference. The performance of excision as a primary operation is not generally countenanced although in Germany a number of surgeons have performed this operation in the hope of arresting the disease in other joints. But it is probable that they have confused the acute stage of hypertrophic arthritis with an infectious polyarthritis in which disease prompt operative interference must soon be considered as the treatment of choice.

Pain due to the grinding together of the swollen and eroded cartilages can usually be relieved by rest and extension. When the acute stage has passed, active hyperæmia tends to prevent recurrence of pain, but occasionally, as in the case reported, every attempt made by the patient to resume his occupation is followed by a recurrence. This is especially true in the knee- and hip-joints, and for such cases I would urge the performance of excision, provided that a careful trial of other methods has been practised.

Stiffness or limitation of motion is due to the presence of thickened bone and of the bony outgrowths from the margins of the cartilages, and while the latter can be removed to some extent it will be apparent that in most cases such an operation would have to be very extensive to effect complete removal. When the hip is involved Goldthwait advises the removal of the entire head of the femur in preference to an attempt to remove the individual nodes, and recently Albee has reported 5 cases of partial excision of the articulating surfaces of the femur and acetabulum by a new method, with relief of the pain in every case and the ability to walk without crutches. Sometimes the spurs project into the joint and produce a hypertrophy of the synovial membrane. In occasional instances they may become detached and form loose bodies in the joint, in which case arthrotomy may be necessary.

Deformity is best treated by prevention during the acute stage which if properly managed will be found on subsidence to have resulted in but little change in the relation of the bones. If ankylosis in bad position does occur, especially in the knee or hip, osteotomy must be considered.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting held April 28, 1909.

The President, DR. JOSEPH A. BLAKE, in the Chair.

PNEUMOCOCCUS PERITONITIS.

DR. GEORGE WOOLSEY presented a girl, 7 years of age, who was taken sick on January 23, 1909, with sore throat, cough, fever, abdominal pain, anorexia and diarrhœa. Five days later she had a sudden sharp pain in the entire lower abdomen, and vomited repeatedly. On the following day the vomiting ceased, but the pain and tenderness persisted.

On admission to the hospital, on January 30, the abdomen was somewhat distended and symmetrical. The respiratory movements were very restricted. The abdomen was rigid and tender everywhere, especially in the right lower quadrant, and there was a sensation of a mass under McBurney's point. The abdomen was tympanitic except over this mass and in both flanks, where there was shifting dulness to the level of the anterior superior spines. An examination of the lungs showed exaggerated breath sounds over both upper lobes anteriorly, and dulness and diminished breath sounds at the right base and over the outer part of the right scapula. The patient's temperature on admission was 104; pulse, 160; respirations, 56. A blood count showed 67,000 leucocytes, with 94 per cent. polymorphonuclears. The blood pressure was 85.

Operation, January 30: Through a muscle-splitting incision the appendix was found in the retrocolic region; it was removed and was apparently normal. The abdominal cavity was filled with pus, watery above, with a few flakes, and thicker and yellow in the pelvis. As no perforation was found after thorough search in this region, a second median incision was made in the epigastrium, and the stomach, gall-bladder and duodenum examined; but no perforation was found. There was but little pus above

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the level. The upper wound was thereupon sutured, and the lower wound closed with a drain to the pelvis. The patient was in fair condition after the operation. She was put to bed in the Fowler position, and continuous enteroclysis given. Her pulmonary condition developed in the next few days into a double lobar pneumonia, and on account of a persistent cough she was placed in a tent with a croup kettle. There was slight distention of the abdomen at first, but after an initial enema the bowels moved freely. The patient's condition was precarious at times, but on the whole she became slightly better. An examination of the pus evacuated from the abdomen showed a pure culture of pneumococcus.

February 6: The patient's temperature at this time was 100.2; respirations and dyspnœa slightly improved; pulse, 140. The enteroclysis and Fowler's position were discontinued. The pulmonary symptoms improved somewhat, and the patient became more rational. There was a slight, shreddy purulent discharge from the lower wound.

During the following week the patient was somewhat better one day, worse the next, and on February 11 the croup kettle was discontinued and she was moved to the roof of the hospital in the open air. Three injections of 10 c.c. of His' serum were given, one on the sixth and two on the eleventh. Her cough had been so severe that the stitches in the upper wound had been torn out. From the time of her removal to the roof, and whether attributable to that or to the use of the serum, she made a gradual but steady improvement. On March 17 the patient suddenly began to vomit, and upon examination of the abdomen an induration was found below the appendix wound. This was broken into by a pair of forceps, and about a pint of foul pus was evacuated. Her further convalescence was uninterrupted, and she left the hospital, cured, on April 10. 1909. She will require subsequent operation for the ventral hernia.

Dr. Woolsey said that very little appeared on the subject of pneumococcus peritonitis in the text-books. In an article by Musser in Osler's System the statistics given showed a very high mortality. Since operating on the above case the speaker said he had seen a second case of pneumococcus peritonitis in a woman, with a history dating back five days, who was brought to the hospital in a moribund condition and who died within a few hours without operation. At the autopsy, nothing was found

excepting free pus in the abdominal cavity which upon examination showed a pure culture of the pneumococcus. The abdominal, pelvic and thoracic viscera were normal.

STRANGULATED INTERSTITIAL HERNIA IN THE FEMALE. PROPERITONEAL HERNIA IN THE FEMALE.

DR. WILLIAM B. COLEY presented these two cases, which are described in full in his paper on Inguinal Hernia in the Female, for which see page 609.

DOUBLE INGUINOPERINEAL HERNIÆ, WITH DOUBLE ECTOPIA TESTES.

DR. COLEY presented a boy of 12 years, who was operated upon at the Hospital for Ruptured and Crippled in March, 1909. On the right side there was found a bilocular hernial sac, the upper loculus being of the inguinosuperficial variety and extending over the aponeurosis of the external oblique half way to the anterior superior spine. The lower loculus extended into the middle of the perineum. The testicle itself was found within the internal ring.

On the left side the sac was monolocular, extending into the perineum nearly to the anus. The testicle was found in the midperineum. The scrotum was entirely empty. The sac was closed on both sides high up beyond the internal ring, precisely as in Bassini's operation for hernia. The lower end of the sac was removed from the perineum, carefully sutured over the testicle, and the testicles then placed in the new pouches made by digital dilatation in the bottom of the scrotum. The cord was not transplanted on either side, and was of sufficient length to allow the testicle to rest in the bottom of the scrotum without tension. The patient made a perfect recovery and left the hospital at the end of two and one-half weeks. The testicles at present were in the bottom of the scrotum, and of normal size.

Dr. Coley stated that he had operated upon 11 cases of inguinoperineal hernia with perineal ectopia, but this was the only case he had seen in which the condition was double. While formerly he believed that in many cases this condition was acquired, he no longer held this view, and now regarded all such sacs as of congenital origin. This case furnished almost positive proof of the congenital origin of the sac, inasmuch as on the right side, while the sac extended into the perineum, the testicle itself was in the abdomen.

THE RESULT OF BIER'S TREATMENT OF TUBERCULOSIS OF THE TARSUS.

DR. WILLY MEYER presented a girl, 30 months old, who had tuberculosis of the tarsal bones of both feet, several of the bones being the seat of tubercular foci. An attempt was first made to extirpate part of the bones, but the disease was so far advanced that this was abandoned for conservative reasons, and Bier's treatment was instituted. Every day the elastic bandage was applied for eleven hours out of every twelve, according to Bier's method, and in addition to this, suction was applied by means of a large glass for 45 minutes, such as was usually employed in the treatment of mastitis, but here adapted to the child's foot with the help of a rubber cuff. After a time, the child was taught to apply the proper amount of suction herself, by working the suction pumps. In this way her timidity was overcome. Gradually, the discharge ceased, and when the patient left the hospital, on August 1, 1908, the sinuses in both feet had entirely closed. She was now able to go about and was practically well. The mother had been instructed to continue the use of the elastic bandage during the night and have braces made to overcome the tendency to the development of flat-foot.

URETEROPLASTY FOR INTERMITTENT HYDRONEPHROSIS.

DR. MEYER presented a girl, 18 years old, who three years ago began to complain of attacks of pain, intermittent in character, in the left lumbar region. These attacks usually lasted for ten or twelve days. At first they recurred every three or four months, and then with increasing frequency and severity until finally the patient became absolutely disabled.

Upon examination, Dr. Meyer found a large tumor in the left lumbar region which was apparently connected with the kidney, and which spontaneously disappeared simultaneously with the pain, in the course of a few days.

Operation: After resection of the twelfth rib through a posterior longitudinal incision, he came down upon an œdematous hydronephrotic sac, only partially filled. The ureter was angled. It was decided to make an attempt to save the kidney. A ureteroplasty was thereupon done, adapting the Finney method to the distended renal pelvis and upper portion of the ureter. On

account of the thinness of the sac only one line of continuous suture could be made. Catgut was used.

There was first some leakage from the wound after the operation, but the patient made a good recovery, and soon began to pass urine in large quantity. She had been free from attacks since the operation and was now apparently enjoying excellent health.

CRANIOTOMY FOR TUMOR OF THE BRAIN: DECOMPRESSION OPERATION.

DR. MEYER presented a man, 47 years old, who was admitted to the German Hospital in February, 1909. His family and previous histories were negative; venereal disease was denied, and his habits were good.

About seven weeks prior to his admission he began to complain of attacks of pain, neuralgic in character, affecting the right side of the head, the corresponding side of the face above the jaw, and the right teeth. These attacks were of gradual onset, occurring as frequently as every two hours, and were of increasing intensity. His eyesight had been failing for ten months.

Examination showed that this area of neuralgic pain corresponded with the distribution of the first and second divisions of the trigeminal nerve. There was weakness of the muscles of the right face and atrophy and weakness of the right masseter and pterygoid. There was increasing optic neuritis of both eyes, particularly the right, with slight nystagmus affecting both eyes. There was analgesia of the face, gums, roof of mouth and cornea of the right side. The gait at times was staggering in character, with deviation always to the right side. The right masseter muscle showed increased galvanic and faradic excitability. While in the hospital, the patient had several epileptoid attacks, consisting of (a) complete loss of consciousness; (b) deviation of the right eye to the left; (c) after these attacks, a paresis of the right abducens.

A tentative diagnosis of tumor of the brain, located probably in the region of the right Gasserian ganglion, was made, and on March 11, 1909, an exploratory craniotomy and decompression operation was done. The important points of this were: (1) The formation of a temporal osteoplastic flap, with its pedicle anterior to the ear. (2) Elevation of the petrosal periosteum,

exposing an apparently normal Gasserian ganglion. (3) Ligation of the right middle meningeal artery. (4) Removal of bone for decompression. (5) Removal of subjacent dura mater. (6) Remarkable thinness of squamous portion of temporal bone was noted. (7) Before incision of the dura, the brain appeared to be under considerable tension. (8) Brain surface did not appear resistant at any place to the palpating finger, also not at the base.

On the seventh day after the operation the flap was noticed to bulge slightly. There was involuntary defecation, and paresis of the left side of the face became apparent. The bulging of the flap gradually became more marked. On the thirteenth day there was paralysis of the left arm and leg; the patient was in a state of coma, and his condition was becoming serious. Puncture of the brain through the flap brought no fluid. Lumbar puncture was then done, and 40 c.c. of clear, straw-colored fluid was withdrawn. Light pressure on the skull flap caused an increase in the speed of the flow, and when the patient left the table the flap was already soft. Two hours later it was slightly scaphoid. On the fifteenth day the wound was again under such tension that a second lumbar puncture seemed necessary. But a few hours later a deep hollow again appeared, where shortly before the flap had been bulging. On the seventeenth day the patient could move the affected arm and leg and was able to answer questions intelligently. Since then his condition had gradually improved. The frequent change in tension of the flap continued for several weeks. According to experiments with various drugs it appeared that the changes were not due to changes in blood pressure, but rather to such in cerebral circulation. The patient had at present only slight weakness in the left arm and leg, with a paresis of the left side of the face and throat. He complained of persistent headache in the region of the vertex. The optic atrophy was increasing, especially in the right eye.

EMPYEMA: IMMEDIATE DISTENTION OF THE LUNG WITH THE HELP OF THE NEW POSITIVE DIFFERENTIAL PRESSURE APPARATUS.

Dr. MEYER presented a boy, 4½ years old, who, when he entered the hospital four weeks ago, gave a history of pneumonia of both left lobes followed by a purulent collection in the left

pleural cavity. A resection of the rib was made in the usual way; and the pus given proper exit. The masses of fibrous coagulation were thoroughly removed. Then the boy's head was placed in the positive differential chamber, and under a pressure up to 14 mm. There was immediate expansion of the inflamed lung. Still, it could not be distended sufficiently to bring the visceral pleura in contact with the costal, however. The wound was not drained. A very extensive dressing was then applied, differential pressure being continued, with the idea of preventing the access of air. Immediately following this operation the boy's temperature dropped, and his breathing was improved. First change of dressing six days later, with positive pressure. Lung seen in front of wound of better (pinkish) color; slight discharge from wound. After another week the boy had a sudden rise of temperature. His head was again put into the compressed air apparatus, and upon removing the dressing it was found that the wound had become closed by granulations. Upon gradually increasing the pressure, these granulations gave way, and there was a tremendous gush of seropus from the wound. A gauze drain was thereupon inserted. Following this, the patient's temperature again dropped. After six days there was another slight rise. He was again placed under the influence of compressed air and a small cigarette drain was inserted, which he still retained. At the present time he was placed in the differential chamber every day, and made to breathe under the increased air pressure. With the aid of such an apparatus, Dr. Meyer said, he thought our method of the after-treatment of empyema would be simplified, especially in adults, in whom it usually took so many weeks to bring the empyema cavity to a definite close. The effect of the differential air pressure apparatus will naturally be of greater effect when resolution of the lung tissue has been completed after cessation of the pneumonic symptoms. It stands to reason, that the inflamed lung with its reduced elasticity cannot be easily distended.

EXPLORATORY THORACOTOMY, UNDER POSITIVE PRESSURE, FOR ŒSOPHAGEAL CANCER.

Dr. Meyer presented a man, 37 years old, who first experienced difficulty in swallowing about seven months ago, due to the presence of a cancerous growth of the œsophagus. The

dysphagia gradually increased, and as it was impossible to dilate the stricture from above, it was planned to make an effort to reach the diseased portion of the œsophagus through an intercostal incision, then draw part of the stomach upwards into the thorax, and after resection perform œsophagogastrostomy. Careful measurements, made prior to the operation, had shown that the œsophageal obstruction was apparently located about six centimeters above the cardia. On April 17 the incision was therefore made in the eighth left intercostal space and the ribs drawn apart by means of Mikulicz's rib spreader. At this point a number of old pleuritic adhesions were encountered, fixating the lower lobe of the lung to diaphragm and chest wall; these were gently loosened. Upon finally reaching the œsophagus, the cancerous growth was found to be located at a higher level, embracing at least five to eight centimeters of the œsophageal tube. It was inaccessible from the exploratory thoracotomy wound. The wound was thereupon closed, as it seemed unwise to tax the reduced patient's strength too much. At a subsequent time, perhaps, Dr. Meyer said, he would undertake a second operation on the patient, making the incision higher up on the thorax. He would then attempt to excise the tumor and close both ends of the œsophagus. A gastric fistula had, of course, to be established for permanent feeding.

MULTIPLE SYMMETRICAL LIPOMATOSIS.

Dr. Otto G. T. Kiliani presented a man, 48 years old, with multiple symmetrical lipomata involving the face, neck, chest, and abdomen. He stated that these tumors, some of which were of mammoth size, so that they constituted a real deformity, began to develop about six years ago. He was first operated on by Dr. Kiliani on June 30, 1906, when three of the growths were removed, one in each parotid region and one underneath the lower jaw, overhanging the chest. He made a prompt recovery from the operation, and there had been no recurrence of the growths at the site of the removals.

Since then a large lipoma had appeared on the back of the neck, and there were numerous others involving the cheeks, mammæ, deltoid region and back. Some of these growths had remained unchanged for a number of years, and one large lipoma of the abdomen had disappeared spontaneously. They had never given rise to any pain or other symptom. Dr. Kiliani said his

intention was to remove those which were unsightly, as they interfered with the man's occupation, which was that of a bartender. (See Figs. 1, 2 and 3.)

THORACOPLASTY.

DR. KILIANI presented a man, 38 years old, who was first operated on in Hamburg about two and a half years ago for empyema, a rib resection being done. He was first admitted to the German Hospital on August 4, 1908, with the following history: About four years ago he had pneumonia, followed in the course of two months by empyema, necessitating a resection. This wound healed, but reopened spontaneously three months later, and after discharging pus for several months it again closed. Since then it had reopened and closed several times. He complained of a dry cough, without expectoration. He had occasional night sweats and had lost some weight.

Examination of the chest at that time showed a cavity which extended upward and forward to a depth of seven and a half inches. No bare bone could be felt. Percussion over the entire right chest wall was flat, with increased fremitus and voice and breathing sounds.

Operation, August 10, 1908, by Dr. Stetten: An incision was made through the old scar and the eighth rib was resected. The sinus which passed through this rib led to a cavity from which about a quart of pus was evacuated. The cavity was packed with iodoform gauze. The patient left the hospital on October 19, 1908, improved, and was referred to the dispensary for further dressing.

When the patient was readmitted to the hospital, on November 29, 1908, the fistulous tract was still open and as there was considerable purulent discharge, he was again operated on, December 3, by Dr. Stetten. At this operation about four and a half inches of three of the ribs were resected, in order to permit the rigid outer wall of the abscess cavity to collapse. In spite of this the discharge persisted, and although the greater part of the wound closed, a fistula remained which led to a cavity running upwards behind the ribs. Bismuth-vaseline mixture was injected into the cavity every second day, but there was no marked improvement. An X-ray plate showed that the cavity extended upwards to the fourth rib.

On March 27, 1909, the first stage of a thoracoplasty was

Fig. 1.

Fig. 2.

Fig. 3

Multiple symmetrical lipomatosis.

done by Dr. Kiliani. The entire scapula was freed, and portions of the fourth, fifth, sixth, and seventh and about seven inches of the eighth ribs were resected. There was considerable bleeding following this procedure, which was controlled by tampons.

Six days later the second stage of the thoracoplasty was done. The anterior portions of the ribs previously resected were removed at the costochondral junction, and a more extensive resection of the upper ribs was done as high up as the fourth, until the entire cavity was laid bare. Its outer wall, which was half an inch in thickness, was removed entirely. Its inner wall, which rested on the lower lobe of the lung, was stripped off. There was considerable bleeding, which was checked by tamponades. As soon as the thick membrane was removed, the lung, which had been incarcerated by this pseudomembrane for two and a half years, immediately expanded, bulging out about four inches. The cavity was packed and the chest flap allowed to fall over, being sutured only at the angles. The patient made an excellent recovery, and now had very fair breathing capacity on the affected side.

DR. CHARLES N. DOWD, speaking of Dr. Kiliani's case of thoracoplasty, said he had obtained the best and easiest exposure of the thoracic sinus by an incision carried upward at the anterior axillary line, cutting off as much from the cut ends of the ribs as was desirable, and removing a portion of the pulmonary pleura, and that the resulting deformity was less than after the Schede operation.

Referring to the expansion of the lung after freeing it, Dr. Dowd said that since the publication of Dr. Lloyd's article, some years ago, he had permitted his patients to come out of the anæsthetic after the incision was made and had allowed them to cough, and in almost every instance this produced expansion of the lung. Almost as much was gained, he thought, by allowing the patient to cough as by the use of an apparatus. He recalled one case where the patient developed a pneumonia in the expanded lung. While early expansion of the lung was of advantage, it had not, in his experience, greatly hastened the closure of the cavity very much over older methods of technic. He had successfully maintained negative chest pressure by means of Colton's apparatus, which was constructed on the principle of the Bunsen filter pump.

DR. KILIANI said that in his case the lung had been incar-

cerated for two and a half years, and the thorax was tremendously thickened. It was at least two and a half inches in thickness, and its removal necessitated a very wide exposure.

DR. MEYER, referring to the possibility of rendering the thoracoplasty wound air-tight, said the use of a rubber dam had been proposed which would allow the fluid to run out without giving access to air. The use of an apparatus with negative and positive pressure would probably go far to simplify the treatment of these cases, and perhaps save the occurrence of long-standing fistulous openings.

HOUR-GLASS STOMACH: GASTROGASTROSTOMY.

DR. WILLIAM A. DOWNES presented a woman, 33 years of age, whose case furnished the subject of a paper by him on Hour-glass Stomach, for which see page 552.

DR. F. KAMMERER said his experience with hour-glass stomach was limited to a few cases. One of them, which he had observed nineteen years ago, was a young girl of about 17 years, who was brought to the hospital in a condition of extreme emaciation. The patient died without operation, and the autopsy showed a narrowing just at the middle of the stomach, dividing that organ into two equal pouches. There were no evidences of any ulcers or cicatrices, and for that reason the case was regarded as one of congenital malformation at the time.

In another case, Dr. Kammerer did a gastroplasty and found it very easy to approximate the edges of the two pouches. This case has been referred to often in medical literature. Under such condition he considered gastroplasty preferable to gastrogastrostomy, because it left one large communication between the two pouches. When the cicatrices were very firm, it might be impossible to do a gastroplasty.

French surgeons have been much interested in the subject of hour-glass stomach lately and have contributed new methods for the treatment of this ailment, such as double gastro-enterostomy and resection of the stenosed portion of the stomach, as hour-glass stomach is so often complicated by a stenosis of the pylorus, the single operations, first referred to, are frequently insufficient.

Montprofit has strongly advised that in all cases in which a gastro-enterostomy was indicated, the anterior operation should be done, and not the posterior, and that a communication should

be established between both pouches by the Y-shaped method. Dr. Kammerer said he was inclined to agree with the suggestion of this French writer in such cases.

DR. CHARLES L. GIBSON said that in the only case of hour-glass stomach that had come under his observation where he did a gastrogastrostomy the patient's nutrition was improved, but the operation failed to relieve the pain, and there was still occasional vomiting. The patient had refused further operation.

DR. CHARLES A. ELSBERG said that during the past six years he had seen two cases of hour-glass stomach, one following carcinoma, the second an ulcer. In the latter he did a posterior gastro-enterostomy, which gave the patient relief. In the first case he did a gastrogastrostomy, making the opening very large, which also gave relief. The opening left between the two pouches was very large and extended from the greater to the lesser curvature.

DR. JOSEPH A. BLAKE said that one cause of failure of these operations was due to the common occurrence of stenosis of the pylorus in hour-glass contraction. A stomach which he saw removed from a child about a year ago, the supposed hour-glass stomach of congenital origin, proved to be atresia of the duodenum, with a widely dilated pylorus.

POSITIVE DIFFERENTIAL CHAMBER FOR INTRATHORACIC SURGERY.

DR. WILLY MEYER demonstrated his new positive differential chamber for intrathoracic operations, which had been erected in a temporary operating room, set aside for the time being for this kind of work at the German Hospital. The same chamber is used as the anæsthetizing room as a part of his "universal differential chamber," which, Dr. Meyer said, he is now testing at the Rockefeller Institute. He described its new constructive features and comparative advantages, laying special stress on the fact that it gives the operator sufficient elbow-room and room for a second assistant on his left side, permits of direct conversation between surgeon and narcotizer, offers opportunity for the surgeon to observe the patient's face and the transportability and therewith adaptability of the apparatus to the requirements of military surgery.

Dr. Meyer also demonstrated a new operating table which he had designed for intrathoracic work.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting held May 3, 1909.

The President, DR. WILLIAM J. TAYLOR, in the Chair.

MULTIPLE FRACTURES, INVOLVING THE FACE BONES, THE
LEFT ELBOW, AND BOTH FEMURS.

DR. ASTLEY PASTON COOPER ASHHURST said that in a paper
on Multiple Fractures, which he read before the Philadelphia
Academy of Surgery in April, 1907 (ANNALS OF SURGERY, 1907,
xlvi, 263) statistics were presented showing that multiple fractures
form only about 1.44 per cent. of fractures in general, and that
the mortality at the present day is at least 25 per cent., even
when cases of crush of the extremities calling for immediate
amputation and other cases dying in a few hours from shock
are excluded. The mortality of fractures in general was found
to be about 2.7 per cent., so that the outlook in a case of multiple
fractures is just about ten times as gloomy as in ordinary cases.
The case now reported, with the kind permission of Dr. Chas.
H. Frazier, is one in which, in addition to numerous other frac-
tures, both femurs were broken and could not be reduced without
operation. Among the 73 cases of multiple fractures from the
statistics of the Episcopal Hospital, reported in 1907, there were
only two in which both femurs were fractured; both of these
patients died. Among 121 recent fractures of the femur at the
Episcopal Hospital, reported a year ago (ANNALS OF SURGERY,
1908, xlviii, 748) in collaboration with Dr. Wm. A. Newell, there
was not one case in which operation had to be done. So that the
present case is remarkable both for his recovery, and from the
fact that operation was required on both femurs.

Frank R., a sailor, aged 26 years, was admitted to Dr.
Frazier's service in the Episcopal Hospital at 7 P.M., December
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5, 1908. While at work on a ship lying at the dock he had fallen a distance of fifty-five feet into the hold, landing on piles of copper ore.

Examination showed the following injuries: There was no vision in the left eye, the pupil being widely dilated, with hemorrhage into the anterior chamber, and dislocation of the lens. The left malar bone was broken near its articulation with the superior maxillary. Both the right and left superior maxillæ were fractured, the line of fracture crossing the median line of the alveolus. There was a comminuted fracture of the nasal bones. The inferior maxilla was broken in three separate places: (1) through the left ramus; (2) just to the left of the symphysis; (3) through the body on the right side. The left humerus presented a fracture of the external condyle; and there was a fracture of the head of the left radius, with dislocation, along with the fragment of the humerus. There was a comminuted fracture of the right femur into the knee-joint, the internal condyle with a fragment of the posterior surface of the external condyle being dislocated posteriorly along with the tibia and fibula, the patella being impacted between the fragments, and the external condyle jutting out and almost rupturing the skin, in the neighborhood of the head of the fibula; the skin, though much abraded and contused, was not broken. In addition to these injuries there was a compound comminuted fracture below the middle of the left femur, with rupture of the ligamentum patellæ. and a large hæmatoma over the seat of fracture.

The man was in profound shock. His temperature on admission was 95.4° F. By midnight it had risen to 97.8° F., and the next morning reached normal. He was appropriately treated for the shock, and though death seemed imminent. dressings were applied to the various fractures. A chin-cap and Gibson bandage were applied to the face; the dislocation of the radius was reduced, and the elbow was dressed in acute flexion. Buck's extension and sand-bags were applied to each lower extremity. It was imposible to reduce the fracture-dislocation of the right knee; and no great force was used in attempting to set the left femur, as the condition of the soft parts (hæmatoma and wound of compound fracture) did not warrant it.

Contrary to expectation. the patient's general condition gradually improved; his temperature on the afternoon of the second

day was 100.6° F., and this was the highest ever reached. The wound in the left thigh healed without becoming infected.

On December 11, six days after admission, Dr. Frazier attempted under ether to reduce the dislocation of the right knee, but was unable to do so. It seemed imperative to secure reduction, as the skin was stretched so tightly over the projecting external condyle that it was feared sloughing would soon occur. Accordingly, the next day Dr. Ashhurst operated for Dr. Frazier, as the patient, though still delirious, seemed able to stand a formal operation. In order to avoid the abraded and granulating skin, which was swabbed with iodine before beginning the operation, the joint was opened as for a fracture of the patella, by a curved incision, with convexity below (the ligamentum patellæ was not divided). This flap was turned up, and the external condyle was found projecting through the capsule of the joint, just beneath the skin. The capsule was therefore opened, but reduction was still impossible, as the patella was firmly fixed between the shaft of the femur, above the external condyle, on its outer side and the inner condyle on the inner side. The patella was rotated about 90 degrees on its longitudinal axis, so that its anterior surface looked outward (Fig. 1). To extract it, the rectus femoris had to be cut from the vastus externus, and then the patella could be pried out from behind the condyles, and the fracture reduced. As very good apposition of the fragments was obtained, no wires, screws, or plates were used to retain them. The quadriceps tendon was sutured again to the vastus externus, and the capsule was then closed, buried sutures of chromic gut being used in both instances. The skin wound was closed with interrupted sutures of chromic gut, and a small drain of plain catgut was left beneath the skin at the outer angle of the incision. This was of course absorbed in a few days, but served the purpose of temporary drainage into the dressings, and obviated the necessity of trapping the cast for its removal. Strict asepsis was used throughout the operation, which took thirty-five minutes. A Buck's extension was then applied, and over all the dressings a plaster cast, which extended from the toes to the groin. The entire operation was done while the patient was lying in his bed, as it was feared that removal to the operating table might injure his other femur. During this anæsthetization the patient's upper and lower jaws, which had begun to knit, were

unavoidably refractured. The next day his temperature was normal, but on the second day it reached 100.6° F., and then again became normal. The cast was left on for over five weeks, and on removal (January 19, 1909) the patella was found movable, and the fragments firmly united and in excellent position. There were a few granulations at the outer angle of the wound, where it had been drained. Passive motion was then begun.

When four weeks had elapsed from the time of the accident,

FIG. 1
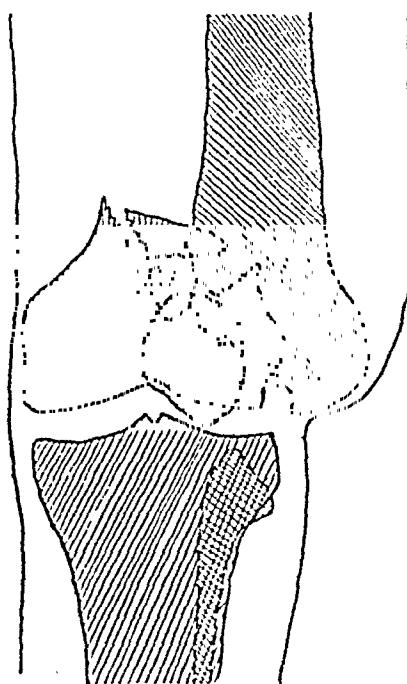
Tracing of skiagraph of right knee. Comminuted fracture through external condyle of femur, with posterior dislocation of tibia and lower fragment and impaction of patella between fragments.

it was found that there was no union in the left femur, which had been the seat of a compound comminuted fracture: and as the skiagraph showed overlapping of about two inches, and as this could not be reduced by traction, it seemed proper to operate on this femur also.

Accordingly, on January 2, 1909, when substituting for Dr. G. G. Davis, and after consultation with Dr. Frazier, Dr. Ashhurst operated on the left femur, through an external incision of 8 inches, excising the callus which prevented reduction, and

removing some loose fragments of the shaft. The upper fragment was anterior and inward, projecting into the rectus muscle. It was possible to secure very good apposition without resecting any of the femur, as the fracture was nearly transverse, and the comminution involved the inner surface only. A silver plate, with three screws in each fragment, was used to retain the bones. The wound was thoroughly washed out with hot bichloride, and was closed with two layers of buried sutures of chromic gut, which was also used for the skin sutures. A rubber drainage-tube was brought out through the lower angle of the wound, passing beneath the bone to the inner side of the line of fracture. The time of the operation was sixty-five minutes. A Buck's extension was applied, and over all a plaster cast from the toes to the groin. The drainage-tube was removed through a window in the cast on the second day. On the third day the temperature reached 100.6° F., and then again fell to normal. This cast was removed February 8, 1909, during the sixth week after operation. The position of the fragments was good, and fibrous union was present.

In March, the patient was about in a wheel chair, and motion in the knees was improving. Dr. Van Pelt took charge of the ocular condition, and sight gradually returned. Early in April the patient began to walk with crutches, and in two weeks time could walk with only one cane. He now walks without support of any kind. The right knee has slight lateral mobility in full extension, and for some time felt a little weak in walking. The left femur has bowed somewhat outward, but union is firm, and the silver plate is producing no irritation. The right lower extremity is only one-half a centimetre shorter than the left. Both knees have a range of motion through about 40 degrees—from full extension to about 140 degrees. The fractures of the face have healed with only slight deformity, the alignment of the teeth being perfect, and very little distortion of the features remaining. The left elbow has a range of motion from 40 to 140 degrees, full extension being impossible on account of thickening of the head of the radius. The ruptured left ligamentum patellæ gives no further trouble. The left eye can now be used for reading, and the patient declares it to be as good as his other eye; the pupil remains dilated.

RESECTION OF COLON FOR CANCER AND FOR TUBER-
CULOSIS.

Dr. JOHN H. GIBBON delivered the annual oration before the Academy upon the above theme, for which see page 571.

SURGICAL ASPECTS OF HYPERTROPHIC ARTHRITIS.

Dr. GEORGE P. MULLER read a paper with the above title, for which see page 630.

INSTRUMENTS FOR OPENING THE SKULL.

Dr. WILLIAM W. KEEN exhibited an apparatus, consisting of a brace with four bits, devised by Dr. W. H. Hudson of Montgomery, Alabama. The peculiarity of the first two (the smaller) bits is that one can penetrate through either a thick or thin skull as far as the dura and the bit will go no farther. The others are globular bits and they will penetrate, but they are provided with a slight button on the end so that when the entire thickness of the skull is penetrated, even if the middle meningeal be directly under the drill, it will be pushed off, provided it is not in either a narrow groove or in a foramen. If it is, of course any drill would cut it just exactly as the ordinary saw or chisel would. The advantage of these bits is that one can very quickly make four openings and then can add three more, intermediate openings if desired, and introduce from one to the other a Gigli saw or bite the bone between them by Devilbiss' or other forceps as desired, turning down a flap in a very few minutes.

In Dr. Keen's opinion these bits provide the best means yet devised for opening the skull, having the safety of the chisel and the speed of the saw.

CORRESPONDENCE.

INTESTINAL ANASTOMOSIS BY INVAGINATION.

EDITOR ANNALS OF SURGERY:

Would you permit me to describe one or two improvements, as the result of additional experience, to the method of performing intestinal anastomosis, an account of which you were kind enough to publish in the ANNALS for May. In two cases of excision of the cæcum for tuberculosis, after removal of the diseased segment, I inverted the edges of the orifice of the distal segment and closed with a "purse-string" suture, which much simplified and shortened the process of occlusion. And, further, I found that a "continuous" instead of an "interrupted" Lembert suture, for uniting the walls of the invaginated bowel to the margin of the incision into the paries of the distal segment, was easier and more rapid in execution.

I would like to add that one important postoperative procedure, which experience has taught this particular method of intestinal anastomosis admits, is that early feeding by the mouth may be indulged in; indeed, food may with perfect security be given as soon as the effect of the anæsthetic has passed off; and in cases of removal of portions of the bowel for tuberculosis or carcinoma this item in after-treatment is of no small moment.

GLASGOW, MAY 24, 1909.   A. ERNEST MAYLARD.

The Success of Listerine is based upon Merit

THE manufacturers of Listerine are proud of Listerine—because it has proved one of the most successful formulæ of modern pharmacy.

This measure of success has been largely due to the happy thought of securing a two-fold antiseptic effect in the one preparation, *i. e.*, the antiseptic effect of the ozoniferous oils and ethers, and that of the mild, non-irritating boric acid radical of Listerine.

Pharmacal elegance, strict uniformity in constituents and methods of manufacture, together with a certain superiority in the production of the most important volatile components, enable Listerine to easily excel all that legion of preparations said to be "something like Listerine."

"The Inhibitory Action of Listerine," a 208-page book, descriptive of the antiseptic, and indicating its utility in medical, surgical and dental practice, may be had upon application to the manufacturers. Lambert Pharmacal Company, Saint Louis, Missouri. but the best advertisement of Listerine is—

LISTERINE

CHOREA

The nervous system in every case of St. Vitus' dance shows a more or less marked depreciation of functional vitality. Valuable as nearly always will be found some preparation of arsenic—Fowler's solution usually—many practitioners have grown to place great reliance on the preliminary or coincidental use of Gray's Glycerine Tonic Comp. The tonic reconstructive effect of this eligible preparation is promptly manifested by a substantial improvement of all vital functions and a very pronounced augmentation of so-called nervous stability. The following prescription with suitable rest, diet, and regulation of the hygiene, is without a peer :

R Liq. Potass Arsenitis ℥ iss
Gray's Glycerine Tonic Comp. ℥ viii
(P. F. & Co.)

M. et Sig : A teaspoonful in water three times a day for a child eight years old.

SPINAL CURVATURE—A PERFECT APPLIANCE APPROVED BY PHYSICIANS AND SURGEONS

Various devices in the form of braces have been introduced to assist in overcoming spinal curvature and other spinal malformations. Many of these have been cumbersome and heavy, so much so as · to defeat the object for which they were being used, and many a person has been allowed to go through life with a deformity that might have been overcome if the right appliances had been used. In this connection we wish to call attention to the "Sheldon Spinal Appliance" advertised on another page.

This appliance is never painful, for the pressure is so evenly distributed that all irritation and soreness is prevented. The muscles are allowed free action, thus preventing atrophy by disuse.

It yields only so much and at such places as is necessary to ease and comfort, and yet sustains and strengthens the weak parts so gradually as to restore them to normal formation and development.

The average weight of the Sheldon Appliance is only 16 ounces. It is durable, capable of easy, accurate adjustment, and is not noticeable under the clothing.

Every Sheldon Appliance is made to conform exactly to individual measurements.

Such devices as heavy plaster casts and other crude and painful appliances can now be done away with. The use of the Sheldon Appliance is much less expensive and is a far more humane and effective treatment, for it conforms to all the natural curvatures of the body, giving an even and continuous support to all the weak points of the deformed spine.

It is endorsed by some of the highest medical authorities and has been thoroughly tested and proved to meet fully the needs of a great variety of conditions, having been successfully used in over 14,000 cases.

The Philo Burt Company, 24 Seventh Street, Jamestown, N. Y., will gladly send a book of information about spinal troubles and best method of cure.

GERMICIDAL POWER OF LYSOL

The germicidal power of Lysol, as shown by laboratory experiments, is as follows :

Staphylococcus Pyogenes Aureus:
Growth diminishes after 2 minutes' exposure in a solution of 0.25 per cent. ;
Growth destroyed or arrested after 15 minutes' exposure in a solution of 0.30 per cent. ;
Growth destroyed after 5 minutes' exposure in a 1-per-cent. solution.

Streptococcus:
Growth destroyed or arrested after 15 minutes' exposure in a half-per-cent. solution.

Anthrax Bacillus :
Growth diminished after one hour in a 2½-per-cent. solution ; no development after six hours.

It must be remembered that laboratory tests for demonstrating the germicidal power of these agents and their use in clinical work involve very different conditions. In laboratory tests the actual destruction of the bacteria by the solution unaided is necessary. In clinical work the process involves both destruction and removal of these growths. Therefore, an agent, to be effective, must possess the power, not only of destroying, but loosening and removing the bacteria from the surface or . structures to which they adhere. Lysol should be especially effective, because it possesses this particular power.

ENTER, THE HUSBAND

Lawrence J. Anhalt, business manager for David Warfield, brings in from the road the story of the manager of a thrilling melo-drama, in one scene of which a husband enters one door an instant after an admirer of his wife has made his exit from another. During a run of a week in one city the manager noticed that one man, obviously from the country, went in every night. Finally he remarked to the man that he must enjoy the performance.

"Tolerably so," replied the playgoer, "but some night that husband is going to catch that other feller,
to see what

SAL HEPATICA vs. NATURAL MINERAL WATERS

The superiority of Sal Hepatica over natural mineral waters that are specially recommended in the Uric Acid Diathesis and the various forms of constipation is clearly shown by the following facts:

By commingling lithium and sodium phosphates in proper proportions with certain of the "Bitter Water" salts, as represented by Sal Hepatica, a compound is secured that is superlatively more active than either the lithium or sodium salt alone, or, indeed, than any natural mineral water or any combination that can be effected. Recognizing this, the most eminent practitioners latterly have taken to prescribing Sal Hepatica in preference to the natural waters, with the result that the remedial action of the latter is enhanced, the untoward manifestations accruing reduced to a minimum, and their palatability materially increased.

FEEDING TYPHOID PATIENTS

In prescribing a sole milk diet for typhoid fever many overlook the fact that milk alone on entering the stomach becomes almost solid, and large, firm curds are likely to prove irritating to the ulcerating surfaces. When patients are fond of milk and seem to digest and absorb it thoroughly, there is no better diet when employed with Bovinine. It answers every requirement of a perfect fever food. Those who dislike milk or do not seem to digest it do well on Bovinine in barley, rice, or plain, and later, when the digestive condition has improved, milk may again be taken up.

A KEEN LAD

"I had always heard that New Englanders were 'smart,'" a young physician who has "graduated" from a village practice remarked the other day, "but I hardly thought it developed at such an early age."

He smiled reminiscently, then continued:

"Just after I settled in Dobbs Corners a twelve-year-old boy called on me one evening.

"'Say, Doc, I guess I got measles,' he remarked, 'but nobody knows it 'cept the folks at home, an' they ain't the kind that talks, if there's any good reason to keep quiet.'

"I was puzzled, and I suppose I looked it.

"'Aw, get wise, Doc,' my small visitor suggested. 'What will you give me to go to school an' spread it among all the kids in the village?'"—*September Lippincott's.*

ETIOLOGY AND TREATMENT OF NEURALGIA FROM A CLINICAL STANDPOINT

John S. Moreman, M.D., in writing under the above title says:— In general terms, I may say, neuralgia is the outgrowth of any disease process which tends to diminish the vital forces, and to deprive the tissues of an adequate supply of nourishment, or such nourishment as is necessary to keep the tissues adequately in repair. When the tissues are inadequately nourished, their vigor and power of resistance is lost, and the establishment of neuralgia may supervene at any time. We may expect to see neuralgia proceed from a lowered physical power incident upon constitutional syphilis and also upon exposure to malarial infection. In fact, malarial influence is a most potent factor in the production of neuralgia.

The treatment of neuralgia comprehends local applications of various kinds, the administration of remedies for the removal of the cause, remedies for the relief of the pain, and the application of certain surgical measures looking toward the removal of tumors, or any other growth upon which the neuralgia may depend. I employ opium now only when the pain is so intense that death is imminent from its effects. Opium and its alkaloids are supplanted now in my hands by antikamnia tablets, which relieve speedily and carry no disagreeable after-effects. When malaria is the cause we will have to depend on quinine, which we can give in combination with antikamnia in the form of antikamnia and quinine tablets, each tablet containing $2\frac{1}{2}$ grains antikamnia and $2\frac{1}{2}$ grains sulph. quinine.

AFTER TYPHOID FEVER

The convalescent period after typhoid fever is always a trying one. Weakened functions must be coaxed back to normal activity, and every effort made to promote proper nutrition. For many years Gray's Glycerine Tonic Comp. has enjoyed the confidence of the medical profession as a most efficient and satisfactory reconstructive for aiding convalescence. It increases the appetite, raises digestive capacity, and rapidly improves the absorptive and assimilative powers. Thus it offers a most tangible aid to the organism at the time when it needs help the most.

JUST THE SAME

Platonic Affection is the name Love assumes when travelling incognito.
—*September Lippincott's.*

ORIGINAL MEMOIRS.

AN ANALYTICAL AND STATISTICAL REVIEW OF ONE THOUSAND CASES OF HEAD INJURY.

(Concluded from vol. l, page 541.)

BY CHARLES PHELPS, M.D.,

OF NEW YORK CITY,

Surgeon to Bellevue and St. Vincent's Hospitals.

V.—PUPILS.—The abnormalities of the pupils are so varied that they are best expressed in tabular form, as they were noted in those fatal cases of the second series in which necropsy was permitted. They are fully representative of the already published cases of the first series (*lib. cit.*).

```
Both pupils widely dilated...............................   7
One pupil widely dilated................................   3
Both pupils fully or moderately dilated.................  22
One pupil fully or moderately dilated...................  19
Both pupils contracted..................................  11
One pupil contracted....................................   3
Normal .................................................  36
                                                         ---
                                                         101
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A similar analysis of recovering cases in the same series affords, with allowance for their greater number, results not essentially different.

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Both pupils widely dilated..............................    7
One pupil widely dilated................................    2
Both pupils fully or moderately dilated.................   56
One pupil fully or moderately dilated...................   38
Both pupils contracted..................................   17
One pupil contracted....................................    7
Normal .................................................  147
                                                         ---
                                                         274
```

23

Percentages:
     Normal pupils—Fatal cases...................... 35%
     Normal pupils—Recoveries 53%

It is probable that the percentage of normal pupils in recovering cases would be somewhat increased if the record had been complete; since in so large a number in which the pupils are unmentioned there is internal evidence that the normal condition was intended to be assumed.

While the percentage of normal pupils is thus much greater in recovering than in fatal cases, the difference is still insufficient in itself to be of value in prognosis. It may be said also in very general terms that the abnormal pupillary conditions in individual cases are of no material assistance in forecasting the result. Death and recovery ensue with both dilated and contracted pupils and whether reaction be lost, impaired, or unaffected. Recovery may follow even when dilatation is extreme and reaction entirely wanting, or death when both conditions are normal. It was thought by Mills [18] that "the more insensitive, dilated and immovable the pupils, the less favorable the prognosis." The analysis of these cases sustains this opinion in one particular. In the few cases in which dilatation was noted as extreme ten were fatal and nine recovered. The pupils were *immovable in all the fatal cases,* and with exceptions, were either normal or sluggish in reaction in those which recovered. The extremity of dilatation with complete fixation therefore may be considered of fatal import, though in one case of recovery, which is apparently exceptional, dilatation was extreme and reaction was entirely wanting as it was in several others in which dilatation was less complete. The danger, however, does not increase progressively with the extent of dilatation or of immobility. Death equally occurs with slight dilatation or none at all, or with contraction, and in either case with normal or but slightly impaired mobility; recovery occurs under the same conditions; and neither death nor recovery can be anticipated from the extent of dilatation or degree of fixation, except as stated when both together are

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[18] Trans. Congress Am. Phys. and Surg., 1889, vol. i.

removed to the farthest. possible distance from the normal state.

The phenomena of pupillary disturbance are many and varied. Their size may be symmetrically or unsymmetrically increased or diminished, and with an alteration in size either one or both may or may not be wholly, or in some lesser degree, without reaction to light or to accommodation or to both; or it may occasionally happen that with no alteration in size reaction may be wanting. The pupillary symptom, though usually primary may be secondary; or again it may change from time to time in the progress of the case; but whatever its nature or period of observance it has no characteristic relation to other symptoms with which it may be associated.

The abnormal pupil is indicative of intracranial lesion, though not necessarily of traumatism, and is so far diagnostic. It has been held in times past that all intracranial injuries were divisible into concussions and compressions; and lesions were ignored, except as to a recognition of bone, blood and pus as compressing agents; if it was concussion the pupils were contracted; if compression, they were dilated. If traumatisms are to be classified in accordance with pathogenic lesions, as better knowledge of their nature and greater accuracy of nomenclature now demands, it will be evident from the post-mortem examination of cases which have been cited that no pupillary condition is representative of any particular form of injury. Such an examination can lead to no conclusion except that any pupillary derangement, or none at all, may be associated with every form of intracranial injury, limited or diffuse, single or multiple, or implicating any cerebral area.

It was believed by Mr. Hutchinson that dilatation and fixation of a single pupil denotes a compression of the motor oculi communis nerve by a hemorrhage into the middle basal fossa of the same side. This explanation though perhaps true of a limited number of cases fails to be substantiated in the much larger number.

In 15 cases of the present series a single pupil was fully or moderately dilated and without reaction: and of these 4

were found to conform to Mr. Hutchinson's formula. The pupil was widely dilated in but 1 of the 4; in this an epidural clot covered the whole hemisphere and extended into the middle and posterior fossæ. In 3 cases in which dilatation was but moderate, hemorrhage in one filled the whole cranial cavity, in another occupied both middle fossæ, and in the third extended only beneath the frontal lobes. The remaining cases afforded no support to the Hutchinsonian contention. Two in which the pupil was widely dilated were cases of laceration; 5 with moderate unilateral dilatation disclosed extensive lesions, all of which were on the opposite side; and in the final 4 there was no basal hemorrhage.

Several other cases in which dilatation was slight may be neglected. The concomitant lesions were varied, but in no case included hemorrhage into the corresponding middle fossa.

There is an anatomical reason for admitting a direct relation to exist between the dilated pupil and the hemorrhage into the corresponding middle fossa; but there are also clinical reasons which compel the recognition of an equally positive, if less direct and obvious, relation between this pupillary change and every other form and site of intracranial lesion. The conclusion of Mr. Hutchinson would seem to have been another instance of too wide a generalization from too narrow a basis of observation.

Both pupils were widely dilated in 7 cases, and were irresponsive in all but one, and in this the reaction was limited to accommodation. In each a hemorrhage, epidural, pial, or cortical, was notable though in each with a single exception there was also laceration of importance. In 22 cases of less extreme dilatation the lesions were more varied. There was in 50 per cent. of these no hemorrhage at all, or none of importance, but a general contusion, pial or cerebral or both, with or without laceration or subarachnoid serous effusion. In several of the others in which hemorrhage was the most prominent lesion laceration was also a well marked feature. It follows that as hemorrhage was the most noteworthy lesion when dilatation was extreme, it was a general contusion when dilatation was of lesser extent.

There was contraction of a single pupil in only 3 cases, and in each the pupil was immovable. Large hemorrhages and a general contusion, which in one instance involved an extensive subcortical laceration, existed in all of them. In the 3 cases considered together all the basic fossæ, and the whole laterosuperior aspect of one hemisphere, were included in the hemorrhages.

In 11 cases, in which both pupils were contracted, hemorrhage was the prominent lesion in 3, general contusion in 6, and a co-existent hemorrhage and contusion in 2. As in unilateral contraction, there was no region of base or vertex which escaped some form of lesion.

The pupils were normal in size and reaction in a large percentage of all the cases examined. The lesions in these cases defy inductive analysis. They comprise all varieties of intracranial hemorrhage and involve every part of base and vertex; they include extreme contusions of both brain and meninges, and lacerations of all the cerebral ganglia except the respiratory and the cerebellum.

ILLUSTRATIVE CASES.

The only example in this series of a wide dilatation and fixation of a single pupil with hemorrhage into the corresponding middle fossa, as shown by necropsy, has been already quoted in illustration of asymmetrical radial pulsations. (Case XLIII—Pulse.)

CASE LV.—*Wide Dilatation of a Single Pupil, with Recovery.*—A man was found at the foot of a stairway in a condition of stupor with widely dilated and irresponsive right pupil, profuse hemorrhage from the right ear, and frequent pulse and respiration. On admission to the hospital he was in shock, restless, and not wholly conscious; his right pupil was still dilated and irresponsive; and he had hæmatemesis, headache, and a lacerated wound in the left parietal region. He had no symptoms except headache after the day of admission.

CASE LVI.—*Dilatation and Fixation of Right Pupil with Lesions Confined to Opposite Side. Necropsy.*—A man fell down stairs, a distance of fifteen feet, and was primarily unconscious. On admission to the hospital he was still unconscious with tem-

perature 99°, pulse 90, and respiration 24. A wound in the right occipital region, was the only evident external injury. The right pupil was dilated and without reaction; the left radial pulse was fuller and more forcible than the right; vesical control was lost; and there was complete paralysis and anæsthesia of the right side. On the second day the movements of the leg were temporarily restored, both pupils became contracted and sensitive to light, temperature increased, and he became restless with some indications of consciousness, but not of intelligence. On the third day the mental condition was unchanged; loss of rectal and vesical control and asymmetry of the radial pulsations was continued, and right hemiplegia was again complete. Subconjunctival hemorrhage appeared in the left eye, and there were moist bronchial râles. He died on the fourth day, pulmonary œdema having increased, paralysis having become complete and unconsciousness more profound, and temperature having progressively risen to 107.6°.

Lesions.—Skull of great thickness and density; separation of left occipitoparietal and occipitotemporal sutures; fracture through left posterior basal fossa into foramen magnum; slight epidural hemorrhage on left side of internal occipital tuberosity; slight pial hemorrhage over left temporal lobe; thick cortical hemorrhage covering anterior border and base of left frontal lobe and first and second left temporal convolutions; subcortical laceration and excavation of whole left frontal, and anterior two-thirds · of left temporal lobe; subcortical disintegration of left optic thalamus; small hemorrhage into left corpus striatum; and deep laceration across posterior border of left occipital lobe. Brain moderately hyperæmic.

CASE LVII.—*Wide Dilatation and Fixation of Both Pupils. Recovery.*—A man was struck on the head by a tackle-block which had fallen about thirty feet. He was found by the ambulance surgeon unconscious, and with both pupils widely dilated and irresponsive to light or accommodation. On admission to the hospital his mental and pupillary conditions were unchanged; temperature 97.4°; pulse 92; respiration 26. He had an extensive and greatly comminuted fracture of the left parietal bone. The membranes were so lacerated that they were indistinguishable; much brain matter was lost; and portions of scalp, fragments of bone, hair and dirt were driven into the cerebral substance. The

wound was cleansed and dressed, and in about one hour consciousness was restored. The pupils were still widely dilated and irresponsive. He vomited, and the bowels were moved by enema. Rectal and vesical control was subsequently lost and not regained for several days. The pupils did not begin to contract or to react till in the second month.

The history of this case is mainly one of mental decadence from left frontal lesion and has been described at length in a monograph published in the *American Journal of Medical Sciences,* May and June, 1902, Case IX,—and is again reproduced later in the consideration of left frontal lesions (Case LXXXIII) and of pupillary derangements (Case LVII).

VI.—THE LOSS OF RECTAL AND VESICAL CONTROL.—

The term loss of control is used here comprehensively to indicate that disorder of the rectal and vesical sphincters which is manifest in ways generally known as incontinence of urine and fæces, and urinary retention. Fecal retention from atony of the rectum, due to local causes, is so common in all conditions of health and disease and so impossible to distinguish from a special form if such exist, corresponding to urinary retention that it must necessarily be ignored. Incontinence has been so often held to denote a relaxation of the sphincters which permits dribbling of urine or a continuous escape of fæces, that misapprehension might ensue if the same word were used to designate the very different condition which obtains in cases of intracranial injury. In default of a single word by which this condition may be expressed with exactitude the phrase loss of control has been substituted. As a matter of further convenience by a rhetorical license, it has been limited to the large majority of cases in which abnormal retention is not a feature; the latter to be considered later as a subdivision of the general subject.

In those cases of intracranial injury in which the rectal and vesical sphincters are involved there is in general neither muscular atony, paralysis, or spasm; but simply an automatic reflex action by which the urine or fecal matter is avoided independently of volition, either with or without the conscious-

ness of the patient. The passage of urine differs from normal micturition in only one necessary particular, the absence of volition. It is usually discharged in practically normal quantity at practically normal intervals, whatever may be the nature of the intracranial lesion. Paralytic incontinence is usually the result of a neglect to relieve active retention, and as such has no claim to recognition as a symptom of injury. A relaxation of the sphincters may occasionally occur when unconsciousness is profound, but it is exceptional, and in nowise characteristic.

In a study of abnormal rectal and vesical conditions they were found to have been specifically noted in more than 350 cases. These cases, whether fatal or ending in recovery, comprised: those in which rectal and vesical control was lacking primarily or secondarily, separately or together; those in which urine was abnormally retained; and finally, those in which rectal and vesical functions were normally performed.

The statistical results of this examination of cases in which rectal or vesical control was lacking were as follows:

Recoveries 73
Deaths 154
                                                       ———
                                                       227
Necropsies 144

Primary Loss 123
Secondary Loss 104
                                                       ———
                                                       227
Loss of both Rectal and Vesical Control................ 111
Loss of Vesical Control Alone.......................... 102
Loss of Rectal Control Alone.......................... 14
                                                       ———
                                                       227

If to these cases there is added those of urinary retention, those in which death occurred too soon for urinary or fecal discharges to take place, and those in which it is specifically stated that these functions were normal, it will make the aggregate of 350 or more cases.

The large remainder of cases, somewhat less than 650, comprise those in which these functions failed of mention, either from neglect or because in the absence of mention their normal condition was intended to be assumed. It is probable that with a proper allowance for these cases the percentage of recoveries would be largely increased.

A recital in detail of the results of observation in the whole number of cases would be unnecessarily fatiguing, but the significance of such rectal and vesical disorders is sufficiently obscure and heretofore unconsidered to warrant some detail in analysis of at least those of the later cases in which symptoms could be confronted with lesions.

In 90 cases of the second series, in which necropsy was made, these rectal and vesical conditions had been noted:

Loss of both Rectal and Vesical Control	37
Loss of Vesical Control Alone	23
Loss of Rectal Control Alone	4
Abnormal Retention of Urine	11
No Fecal or Urinary Discharge	12
Normal Control retained till Death	3
	90

Primary control of both functions was retained in 16 cases, and in each the patient was conscious, and in 6 was without mental impairment. Twelve of these lost rectal or vesical control, or both, in from two to eleven days; and when the loss occurred on the second day it was always attended by stupor, unconsciousness, or delirium.

Primary loss of control was noted in 30 cases under varied mental conditions: Consciousness with normal mental state obtained in 2; stupor or delirium in 6; and unconsciousness in 22. Control was not regained in either of those primarily conscious, whether the mental state was normal or abnormal, and in only three of those primarily unconscious.

A loss of rectal or vesical control was as often secondary as primary, i.e., was first noted at some time subsequent to the day on which the injury was received. In a certain number of these cases primary control is definitely stated in

their history. In the larger number no mention is made of its presence or absence. In 50 per cent. of those in which such mention is neglected the patient was conscious; in 25 per cent. he was unconscious; and in 25 per cent. he was in stupor or delirium. The fact that in a large proportion of those cases in which this point in history failed of record on the first, it was noted on the second day would seem to suggest that there was neglect in noting the earlier condition. It may also be true that in the absence of note to the contrary its presence was meant to be inferred.

'On the day when secondary loss of control was first noted the patient was usually unconscious, delirious or in some degree mentally incompetent. In 3 cases only was control regained; 2 of these were delirious primarily as well as when control was lost, when it was regained and when lost again, the third, in which rectal control alone was lost and at variable intervals, suffered progressive mental decadence. The lesions were respectively: moderate epidural and extensive pial hemorrhage, marked cerebral œdema, severe pial contusion with subarachnoid serous effusion; cortical hemorrhage from frontal lacerations; and great cerebral hyperæmia and œdema; and in the case last mentioned cerebral sclerosis and marked left frontal atrophy.

In more than 50 per cent. of the cases involved rectal and vesical control were lost together, and in all those remaining, save four, it was the bladder which was alone at fault; and when the bladder and rectum were successively, and not simultaneously affected, it was the bladder control which was usually lost primarily.

In 1 of the 4 exceptional cases, in which rectal control alone was lost, the patient was conscious until his death twelve hours after admission to the hospital; in another he was slightly delirious, and control was lost on the second day, death occurring on the third; in a third case, the patient who was then delirious required catheterization on the second day, voided urine naturally on the third, lost vesical control on the fourth, lost both rectal and vesical control on the fifth, regained both

on the eighteenth, and again lost both on the twentieth day. The lesions disclosed did not account for these anomalous conditions. The first mentioned of these cases was that of a gunshot laceration of both cerebellar lobes with cortical hemorrhage at the vertex and in both posterior basal fossæ; the notes of necropsy of the second were confined to fracture; the temperatures, however, had indicated a general cerebral contusion; the third case showed marked cerebral hyperæmia and œdema with lacerations of the right frontal and temporal lobes, and a considerable cloudy subarachnoid serous effusion, and no hemorrhages. In the fourth and last exceptional case, which was of long duration, vesical control was maintained throughout. Rectal control was occasionally lost in the early part of the second month, but toward its end was again perfect. At the end of a year it was habitually lost for about three, and in the fifteenth month for about two days out of seven. The patient died soon afterward. His mind until near the close of the year was active; he was coherent, capable of initiative, and suffered only from delusions which for a long time were confined to locality,—later, mental decadence was general and progressive. He was found at necropsy to have suffered general cerebral sclerosis and marked left frontal atrophy as has been noted in another connection.

The loss of rectal control alone with later necropsy occurred in the first as it did in the second series of cases in three instances only, but in one of them not till final unconsciousness on the seventeenth, and last day of life. In one of the two remaining cases it was confined to a period of primary unconsciousness, and in the other it was secondary, and the mental condition was one of stupor; in both there was found a temporal laceration and extensive cortical hemorrhage.

In each series there was a very limited number of cases in which primary rectal was followed by considerably later vesical loss; and a further limited number of cases in which with primary vesical a later rectal loss followed before both occurred together. A case from the second series will be cited later as illustrative of the conditions last mentioned.

The number of fatal cases without necropsy, as well as of those which recovered, in which loss of rectal control occurred independently of vesical loss, was as limited as that of those with vesical loss already considered. The whole number in all cases of both series (1000 cases), in which with rectal loss vesical control was at the same time primarily and permanently retained was but fourteen, and the number in which independent rectal loss followed primary vesical loss, or alternated with it, was still less. The attendant conditions as regarded states of consciousness and mental competency were the same in both fatal and recovering cases. The paralysis and diminished reflexes observed in one instance cited were not noted in either of the others examined. Coincident retention of urine with necessary catheterization occurred in a noteworthy proportion of cases.

In fatal cases in which both vesical and rectal, or vesical control alone, was lost and in which post-mortem examination was not practicable, attendant conditions were naturally similar to those already noted where such opportunity was afforded. In 50 per cent. of these, primary control was retained with more or less complete unconsciousness, delirium, or rational intelligence. Cases of rectal or vesical default, occurred from the second to the forty-second day. When control was long maintained the patient was in some instances in stupor but fully conscious and intelligent at time of final loss.

In recovering cases these losses were in much smaller proportion. The loss when it occurred was much oftener primary than secondary, without regard to mental condition, and as in the fatal cases was usually vesical when only a single function was involved. The loss if secondary usually occurred on the second or third day. In one instance, however, control was retained till the thirteenth day, when vesical control was lost. The patient, previously delirious, was then rational though apathetic.

Loss of control as it has been considered has referred exclusively to unconscious or involuntary discharges from the

bladder or rectum. In a very much smaller number of cases there was an abnormal retention of urine which required catheterization. The whole number of cases in both series was 53, scarcely more than 5 per cent. of the total of 1000. Twenty-eight were fatal and in 17 of these the use of the catheter was required on the first day as it was in 16 of the 25 recoveries. In the others retention occurred from the second to the eleventh day. The pupils were in most instances abnormal, and much oftener dilated than contracted. Coincident fecal discharges, with or without control, occurred in a number of instances, and when life continued for some length of time, especially if the ending were fatal, rectal or vesical discharges occurred secondarily without volition. The mental states, and the lesions when disclosed, were as varied, as were those in cases previously examined in which discharges were without normal restraint.

It appears from this review of both fatal and recovering cases that rectal and vesical control is lost or retained under all mental conditions and following all recognizable forms of cerebral injury. The same patient may lose and regain, or retain and subsequently lose control during a continuance of the same mental state. It is equally independent of muscular power or of general reflex conditions.

As in many cases the patient is unconscious, or actively delirious, the loss of control might be supposed to depend in them upon deficient perception or deficient will power, as it may do under the same conditions in cases apart from intracranial traumatism. This explanation, however, does not serve to account for the default in the large number of cases of mild delirium, delusional mental disorder or moderate degrees of stupor; and still less for the considerable number of others in which entire consciousness and rational intelligence are maintained.

It is impossible to find an explanation for the rectal or vesical defect in the character or site of intracranial lesions. They have been found to be both limited and diffuse, nearly always multiple, and to affect all cerebral and meningeal

regions. In a study of the first series of cases it was ascribed to cerebral laceration; and a consideration of those cases probably seemed to justify a conclusion. The post-mortem findings in the present larger number of cases fail to confirm its correctness. Laceration, in fact, existed in somewhat less than half of the number comprised in the combined series, and in many was complicated by hemorrhage, and in all by some farther manifestation of a wider cerebral injury. In a large percentage of cases it involved the left frontal lobe, but not sufficiently often to warrant an association of the rectal or vesical default with the usual mental defects dependent upon lesion of that region. In view of the universality of the general lesion, and in the absence of a constant or even characteristic limited brain injury, it is evident that the sphincters have no special centres of even contributive control corresponding to those which have been demonstrated for other muscles.

In a "Contribution to the Pathology of the Sphincters" (ANNALS OF SURGERY, 1901, vol. xxiv, Corner), the writer after observing 100 cases of head injuries, and remarking that figures are valueless concludes that "the figures themselves show that the main cause (of affection of the sphincters) is the amount of violence; as in concussion of the brain the affection of the sphincters is infrequent, whilst in fractures of the skull, etc., they become more frequently affected." To this statement it may be excepted: first, that the amount of violence inflicted upon the cranial contents is not to be measured by the occurrence of fracture, or its absence; and second, that the dependence of affections of the sphincter upon the amount of violence inflicted can only be determined by the figures which he contemns. As a matter of fact intracranial injuries are no less severe when the cranium is intact; and a reference to the records of the cases cited in this paper shows that in them in proportion to their number affections of the sphincter are no more frequent with fracture than without. It has been further shown that in the 1000 cases 217, or nearly one-fourth, were without fracture, while loss of control in them occurred in a ratio of one to three as compared with

those in which fracture was an incident. If it be true that affections of the sphincters are frequent in proportion to the amount of violence inflicted, *ceteris paribus*, it is no less true of other symptoms of importance.

The same author arrives at certain other conclusions which are equally at variance with those deducible from observations made in the present series of cases. His classification is simple and seemingly independent of pathology. " Concussion is a condition in which the symptoms are most severe at the time of the receipt of the injury, and then progress favorably; " while in compression " they get progressively more severe if allowed to take their course "; and " fractures of the skull present in their general symptoms the signs of concussion, compression being excluded, and the diagnosis of contusion or laceration of the brain uncertain." It is of course impossible to follow his study of disordered action of the sphincters with such a classification of cases if we accept a present pathology in which concussion disappears, compression apart from contusions becomes most infrequent, and cranial fracture has few general symptoms of importance, except through its complications which are identical with those conditions which equally occur in its absence. His first subdivision would include all cases of recovery, urinary retention occurring in nearly 23 per cent. as against less than 5 per cent. in all classes of recovering cases in the present series. His cases of compression would probably be identical with those in which are found the lesions of contusion; in these he states, " active retention will rather probably have occurred during preliminary concussion which passes on to the passive retention of paralysis, and when the symptoms of compression are marked paralytic overflow takes place."

This has not been the history of the cases upon which the present paper has been based.

Finally: 8 out of his 13 cases of cranial fracture, nearly two-thirds of their number, " showed affection of the sphincters, all of which were active retentions, 4 being allowed to proceed to incontinence."

This percentage differs widely from that noted in the

cases which have been cited here. Urinary retention occurred in only 39 out of 783 cases, none of which were permitted " to pass on to the passive retention of paralysis."

Normal urination is an automatic reflex action wholly dependent upon the sympathetic system. The habitual intervention of consciousness and volition is not essential to the proper performance of the function. The expulsive force of the detrusor muscle is excited exclusively through the ganglia of that system, and the restraining power of the vesical sphincter is so far controlled by them that even in health the influence of the cerebral centres may be suspended when excitation has reached a certain degree of intensity. The interposition of consciousness and volition while not essential to the voidance of urine is nevertheless requisite to the wellbeing of the individual, and when prevented is indicative of functional or structural disease. The cases of intracranial traumatism which have been cited show not only that the methodical expulsion of the rectal or vesical contents may continue for a length of time when both consciousness and volition are wanting, but that with full consciousness and with volition otherwise unimpaired these discharges may be involuntary.

It is evident from this view of the facts connected with uncontrolled action of the sphincters in cases of intracranial injuries :—

That it is a true symptom and not a mere accident of suspended consciousness or mental impairment.

That while of no service in prognosis, or as an indication for treatment, it has much diagnostic importance.

That it is characteristic of intracranial injury, and at the same time independent of the nature or site of lesion.

That it must therefore be an indirect rather than a direct symptom.

That its origin is to be found in some interruption of a harmony of function between the cerebral and sympathetic nervous systems which is a result of direct injury of any part of the brain or its membranes.

That it is thus etiologically allied to asymmetrical arterial pulsations and to pupillary disturbances.

The dependence of abnormal circulatory and pupillary conditions upon a secondary implication of the sympathetic system is even more directly obvious than is that of the uncontrolled action of the sphincters. The exclusive control of the vascular system by the sympathetic must necessarily involve its immediate responsibility for abnormal no less than for normal conditions. The channels through which the influence of the intracranial lesion is exerted is less certain, but it seems probable that it is through the sympathetic filaments which are everywhere distributed upon the cerebral vessels.

The direct connection between the intracranial injury and the abnormal condition of the pupil is more nearly demonstrable. As was long since determined the reflex movements of the iris, though made through the medium of the ophthalmic ganglion, derive their original stimulus through the motor oculi communis nerve. Hutchinson observed the dilatation of the corresponding pupil from direct intracranial pressure of extravasated blood upon that nerve in its passage through the middle fossa. It is conceivable that any other intracranial lesion may more indirectly reach the ophthalmic ganglion through the same channel and produce the same pupillary effect.

It will be unnecessary to cite many cases to illustrate the lack of rectal vesical control when no longer subjected to the will. Case XL (see Temperature) is further illustrative of the purely automatic character of the reflex action of the vesical sphincter in cases of intracranial injury; and in this connection three cases may be quoted in which the distinctly automatic action of the rectal and vesical sphincters is clearly demonstrable.

CASE LVIII.—*Automatic Action of Both Rectal and Vesical Sphincters. Recovery.*—The patient was admitted to another hospital in an unconscious condition following a suicidal pistol-shot wound in the right temporal region. The positive symptoms

were: drowsiness; stupidity and slowness of speech; lack of vesical and later of rectal control; ptosis; and slight dilatation of the left pupil. Temperature rose to 101°. One week later an epidural clot about the size of an English walnut was removed from the left posterior frontal region. Temperature became normal and there was gradual mental improvement. Rectal and vesical control remained in default.

He was admitted to Bellevue Hospital on the thirty-fifth day. His symptoms then were: slight headache; a nervous and restless manner, with at intervals a vacant look; exaggerated reflexes; a distinct ankle clonus; and a lack of rectal and vesical control with full consciousness of natural desire. Ten days later control of both functions was regained.

In a similar case with recovery, after the disappearance of all other symptoms, rectal and vesical discharges were still involuntary although the patient in each instance was conscious of the impending event.

CASE LIX.—*Loss of Both Rectal and Vesical Control. Recovery.*—Patient unconscious and vesical control lost on admission to the hospital. On the third day his mental condition was practically normal and vesical control was regained; on the fourth day he was delirious; and on the fifth day had delusions; on both days vesical control was again lacking; on the seventh day he was rational and intelligent but still without vesical control, and with rectal control variably lost or retained; on the ninth day he was mildly delirious and both rectal and vesical control was lacking; and on the tenth and eleventh days though his mental condition was entirely normal, both rectal and vesical control was still lost.

CASE LX.—*Primary Vesical, and Secondary Rectal, Loss of Control, with Still Later Loss of Both Together. Necropsy.*—Patient unconscious when admitted to the hospital and vesical control lost.

Second day: patient conscious and rational; incomplete left hemiplegia; continued loss of vesical control.

Third day: vesical control regained; no other change.

Fourth day: patient delirious; muscular power on left side regained; general convulsions; vesical control again lost.

Fifth and sixth days: mental condition normal except for occasional delusions; vesical control regained; rectal control lost.

Seventh and eighth days: mental condition normal; vesical control lacking; rectal control variable.

Ninth day: mild delusions; left arm rigid; deep reflexes diminished; rectal and vesical control both lacking.

Eleventh day: patient rational; patellar reflexes present; no rectal or vesical control; and neither subsequently regained.

Necropsy.—Excessive general meningeal hyperæmia; limited areas of meningeal contusion with corresponding serous and hemorrhagic effusions; subcortical excavation of both frontal lobes.

VII.—MINOR SYMPTOMS.—There are certain other general symptoms of minor importance and not peculiar to head injuries. Two of these only are of frequent occurrence.

Vomiting is perhaps the most frequent, and has certainly been accorded the most consideration. Hæmatemesis, the ejection from the stomach of blood swallowed in succession to hemorrhage into the mouth or nares, should be excluded as being a gastric symptom, merely mechanical and only indirectly connected with the cranial or intracranial injury. With this proper limitation vomiting occurred in about 13 per cent. (132) of the total number of cases, usually very soon after admission to the hospital or even earlier, but occasionally delayed for a number of hours. It sometimes occurred but once, and sometimes continued even till the following day. The matter vomited was most frequently undigested food, occasionally with a little admixture of blood which in other cases gave a brownish tinge to a mixture of bile and gastric fluids. It was profuse or scanty according to the amount of food the stomach happened to contain. It was not often associated with symptoms of general shock, nor in a majority of cases with a subnormal temperature. It occurred in a rather larger percentage of cases with the much smaller number of children injured than with adults. In short, it had no special characteristics which distinguished it from vomiting under any other circumstances. Its chief importance seems to reside in the fact that it has been counted among the diagnostic symptoms of so-called concussion. It is unnecessary to

confront this symptom in detail with the lesions with which it has been found to be associated. In the twenty cases in which opportunity was afforded for post-mortem inspection the lesions in each instance were markedly severe, and as in case of asymmetrical pulse, abnormal pupil and loss of sphincteric control, it represented all forms of intracranial hemorrhage and contusion, and involved all intracranial regions. There is no reason to doubt that like them it is a result of disturbance of the sympathetic system of nerves. It is associated with no special intracranial injury, has no distinctive characteristics, and is entirely independent of volition. It differs in no respect from vomiting induced by any other form of sudden injury, or by mental shock or violent emotion.

The occurrence of chill or of a profuse perspiration is too infrequent, and of too little apparent significance to justify more than brief remark. Two cases in which there had been a chill were subjects of necropsy. Symptoms had been diverse, but in each cerebral œdema and hyperæmia were excessive, with a large pial hemorrhage in one and a large epidural hemorhage in the other. As similar conditions are habitually observed without the chill, there is no reason to suppose a special relation to exist between them in these very exceptional instances.

Chill, like vomiting, is not an unusual indication of any severe shock mental or physical, sustained by persons of susceptible nervous organization. Perspiration more or less profuse, occurring in rare instances as a primary or later symptom, has no greater significance. It is a simple trophic disturbance with which the cerebral nervous system can have no more intimate connection than when it occurs under other and more ordinary circumstances.

Headache and vertigo belong to another category of symptoms. They are the result of the meningeal or cerebral circulatory derangement, and in nowise differ in character from the same symptoms as they attend similar derangements following indigestion, a febrile action, or other morbid state. As circulatory conditions are always altered in case of intra-

cranial injury, headache is naturally one of its frequent indications, and usually denotes hyperæmia. Vertigo is less frequent and is oftener the result of anæmia. Headache has no further significance. It may be early or late, intense or moderate in degree, general or localized; but aside from certain cases of cranial fracture does not point to the site, severity, or nature of the lesion.

Vertigo as a focal symptom from injury of the eighth nerve will be found in a number of the cases of fractured base with hemorrhage from the ear.

VIII.—MUSCULAR DISORDERS.—The muscular disorders were both local and general. Their character, and comparative frequency in fatal and recovering cases are shown in their classification:

Convulsions:
    Fatal cases 75
    Recovering cases 35
                                            110
    Necropsies 50

Convulsive Movements and Minor Muscular Contractions:
    Fatal cases 56
    Recovering cases 24
                                            80
    Necropsies 44

Muscular Rigidity:
    Fatal cases 101
    Recovering cases 29
                                          130
    Necropsies 71

<div align="center">PARALYSIS.</div>

General:
    Fatal cases 6
    Recovering cases 2
                                          8
    Necropsies 6

Paraplegia:
  Fatal cases 1
  Recovering cases 2
                         —
                         3
  Necropsies 1

Hemiplegia:
  Fatal cases 44
  Recovering cases 24
                         —
                         68
  Necropsies 27

Upper Extremity:
  Fatal cases .... 10 ,
  Recovering cases 14
                         —
                         24
  Necropsies 6

Lower Extremity:
  Fatal cases 2
  Recovering cases 0
                         —
                         2
  Necropsies 2

Face:
  Fatal cases 30
  Recovering cases 31
                         —
                         61
  Necropsies 18
  Ocular Muscles 50
                  (Approximately)

The actual percentage of cases characterized by derange-ments of muscular action is somewhat less than that indicated in these tables, since in at least one hundred, two or more co-existed in the same individual.

Convulsions, Convulsive Movements, and Muscular Rigidity.—When the present series of 1000 cases was examined in blocks of 100 some remarkable variations were observed in the comparative frequency with which convulsions

had occurred. The average number of cases was 10 and a fraction for each 100; but while in the fourth hundred there were 19, in the eighth there were only 3, and in the ninth again there were 12. This is important only as showing the absolute necessity of statistics being compiled upon a large scale if they are to be of value. Similar discrepancies have been often noted in the comparison of other conditions when they have been studied in the same numerical subdivisions.

The conditions which may predispose to convulsive attacks in cases of intracranial injury do not seem to be largely operative. The most important is sex. Nine only of the 110 cases observed were of females, and the importance of a large aggregate of cases for statistical deduction is again evident in the fact that but one of these occurred in the last 500 cases. Three of the 9 were young children, and 3 were suffering from alcoholic excess.

The relation of age to frequency, and to prognosis, may be best shown in tabular form.

	Cases.	Recovered.	Died.
From 2 months to 8 years...........19		6	13
From 10 to 20 years.................13		5	8
From 20 to 30 years.................23		12	11
From 30 to 40 years.................19		4	15
From 40 to 50 years.................14		3	11
From 50 to 60 years.................16		1	15
At 70 years......................... 1		1	0
	105	32	73
Adults—age not specified........... 5			
	110		

The 19 cases in infants and young children were all that occurred in a total of 102 instances of intracranial injury in children, three-fourths of whom were less than 7, and none more than 10 years of age. Simple convulsive movements occurred with about the same frequency. It is apparent from these figures that early childhood, not less than womanhood resists, rather than predisposes to, convulsive attacks—con-

sible to ascribe to them definite relations to other general symptoms by which they were accompanied.

Muscular rigidity, like simple clonic muscular contractions, occurred either by itself or as an accompaniment or precursor of other abnormal muscular conditions. Like the clonic contractions it was general or limited, early or late in its manifestation, transient or permanent, and of a greater or lesser degree of intensity. Unlike the localized clonic contractions, which often terminated in a general convulsion, it did not tend to a general tonic spasm.

A general pial or cortical hemorrhage or subarachnoid serous effusion in many cases attended general rigidity or convulsive movements; and less often a local lesion corresponded to a limited muscular disturbance; but the exceptions to such a correspondence were too numerous to permit its acceptance as a general rule. The following instances will serve as illustrations:

1. *Cervical Rigidity*—noted on third day.
Lesions: Epidural and pial hemorrhages in right middle basal fossa; subarachnoid effusion confined to vertex; general cerebral hyperæmia and œdema.

2. *Cervical, Followed by General, Rigidity.*—Cervical rigidity on the fourth, with rigidity of upper and lower extremities on the fourteenth, and increased cervical rigidity on the twenty-first day.
Lesions: Laceration of the inferior surface of left frontal lobe with large cortical hemorrhage in anterior and middle basal fossæ; moderate subarachnoid effusion at vertex; none at base.

3. *General Rigidity.*—Primary general convulsive movements followed by a general spastic condition of the muscles.
Lesions: Limited cortical laceration and contusion of right temporal lobe, with cortical hemorrhage in all the right basal fossæ.

4. *General Rigidity.*—Primary; more marked on right side.
Lesions: Small epidural hemorrhage over left frontotemporal junction; laceration of first and second left temporal convolutions with cortical hemorrhage limited to the temporal (lobe) region.

5. *Rigidity of Right Arm and Leg.*—Primary.
Lesions: Epidural hemorrhage over left, and pial hemorrhage over right temporal lobe; contusion of all the right temporal convolutions; small amount of serum in each lateral ventricle.

6. *Rigidity of Left Arm and Leg.*—Primary; later the left extremities became restless; the right extremities remained motionless.
Lesions: Subacute arachnitis confined to posterior parietal and occi-

pital regions; slight pial hemorrhage upon left inferior cerebellar surface, limited contusion of fornix posteriorly; excessive general hyperæmia and œdema.

7. *General Rigidity:* Manifested on eighth day; most pronounced in right upper extremity.

Lesions: Decolorized thrombi in both lateral and both inferior petrosal sinuses; entire brain, including cerebellum and basal ganglia, hyperæmic with moderate œdema.

8. *General Convulsive Movements:* at end of first day.

Lesions: Moderate subacute meningitis with serous effusion limited to right parietal region; purulent effusion at base; limited cortical contusion of left temporal lobe; excessive cerebral hyperæmia and œdema.

9. *General Convulsive Movements.*—Primary; gunshot wound.

Lesions: Ball passed through right hemisphere anteroposteriorly on a plane slightly above the corpus callosum.

10. *General Convulsive Movements.*—Primary and strongly marked, involving various sets of muscles.

Lesions: Epidural hemorrhage from rupture of left sigmoid sinus; pial hemorrhage over left parietal lobe; cortical contusion of left temporal lobe.

11. *Convulsive Movements of Right Side and Rigidity of Left Side.*—Both conditions primary and strongly marked.

Lesions: Epidural hemorrhage covered whole lateral surface of right hemisphere and to within one inch of median fissure. Cortical hyperæmia; slight contusion of second left temporal convolution.

12. *Convulsive Movements of Both Arms.*—Primary.

Lesions: Cortical hemorrhage over inferior surface of both frontal lobes, and over superior surface of cerebellum; laceration of inferior surface of left frontal lobe; subcortical contusion of anterior portion of right optic thalamus with punctate extravasations and of pons in transverse fibres; moderate cerebral hyperæmia and œdema.

13. *Single General Convulsion:* Preceded by left hemiplegia, and accompanied by rigidity of left upper extremity on the fourth day.

Lesions: Four areas of meningeal contusion; one over each frontal lobe and one over each parieto-occipital junction; each about two inches in diameter with subarachnoid serous and hemorrhagic effusion; small contusion of right temporal lobe; subcortical excavation of both frontal lobes extending into right motor area.

14. *Multiple General Convulsions.*—Seven convulsions on the second day, preceded on the first by convulsive movements.

Lesions: Extensive laceration of left temporal lobe, and effused hemorrhage in middle and anterior basal fossa; blood in great part had escaped through cranial fissures into tissues about the eye.

15. *Unilateral Multiple Convulsions.*—Primary; began in face; first preceded clonic contractions.

Lesions: Direct laceration of dura and pia mater and lateral surface of right temporal lobe at point of fracture; cortical hemorrhage in right middle and posterior basal fossa.

It is evident from these illustrations, which might be greatly extended, that while a meningeal or cortical le almost invariably exists, and is usually associated with more deeply seated, both tonic and clonic muscular con tions are independent of the exact site or nature of le The occasional instances in which the motor zone is dir affected by gross injury or pressure are but accidental; even when this area is involved it is usually by a hemorr or subarachnoid effusion insufficient in amount to be of n apparent importance in explaining the muscular disturba as of focal origin. The extreme frequency of lesion temporal lobe is worthy of note.

Paralysis.—Traumatic differ from idiopathic para only in their origin and in the nature of their lesions. eral paralysis and paraplegia, however, are so infrequer the course of intracranial injuries as to justify some sp reference to the history of such as are included in the pr series of cases.

General Paralysis.—One of the eight cases noted evide resulted from a coincident injury of the spinal cord, and patient was discharged from the hospital on the twenty-se day with incomplete recovery. In a second case the pa survived under observation for six months. He had jur from a ship's deck to a raft alongside, a distance of two five feet, and was at once admitted to the hospital with hemiplegia and paresis of the right upper extremity. He later generally hyperæsthetic with the exception of the leg which was anæsthetic. The still later symptoms incl those referable to lesion of the left prefrontal region w continued, together with the loss of power in the para leg, at the time of his discharge from the hospital.

The six cases remaining were all fatal, and the relatio muscular conditions to lesions were as follows:

CASE LXI.—Manner of injury unknown; patient unconsci left pupil dilated and both pupils without reaction; respir shallow; total paralysis.

Lesions.—Fracture extending from torcular herophili to foramen magnum; pial hemorrhage filling both posterior and basal fossæ; general cerebral contusion with œdema and much serous effusion in both lateral ventricles. Died in ambulance.

CASE LXII.—Patient fell fifteen feet, striking her head upon the pavement; unconscious; primary right hemiplegia, and paresis of left side and right face; both patellar reflexes lost; respiration ceased abruptly; cardiac pulsations continued for an appreciable interval. Died in twenty-four hours.

Lesions.—Fissure extended from left inferior parietal region through petrous portion into middle basal fossa; large subcortical excavation of left temporal lobe; blood breaking through the cortex at one point from which a thick clot extended over the anterior part of the lobe and in a thin sheet covered the whole left frontal and parietal lobes and anterior part of left occipital lobe. Blood had also flowed from the left temporal region through the Sylvian and median fissures and formed a thick clot over the pons and medulla; moderate cerebral hyperæmia and œdema.

CASE LXIII.—Patient fell down one flight of stairs; coma; pupils dilated and irresponsive. Paralysis general. Died in eight hours.

Lesions.—Fracture extending from right occipital inferior curved line across petrous portion, and into sella turica; laceration of inferior surface of right temporal and frontal lobes; cortical hemorrhage filling right anterior and middle basal fossæ, and extending in a thick clot over frontal lobe and into median fissure; large pial hemorrhage covering superior surface of both hemispheres; hyperæmia and punctate extravasations throughout the brain.

CASE LXIV.—Patient struck upon the head with a club; a little later sudden loss of consciousness with general slight convulsive movements which soon ceased, but recurred two hours afterward; immediately followed by general paralysis, including both sides of the face with divergent strabismus. Died in twelve hours.

Lesions.—Fine fissure extending from mid-frontal region into left middle basal fossa; pial hemorrhage thickly covering left hemisphere and forming a thin sheet upon inferior surface of cerebellum; no lacerations; minute contusions of right temporal.

and inner border of left temporal lobe and of first orbital convolution; moderate hyperæmia and excessive œdema of all parts of the brain.

CASE LXV.—History unknown; coma; respiration at times irregular; paralysis of both upper, and paresis of both lower extremities; general impairment of sensation; slight movement of fingers and of right wrist; patellar reflexes absent. Died on third day.

Lesions.—Fracture extending from right temporal bone into foramen magnum; epidural hemorrhage in a thick clot flattened right vertex and extended to base; no lacerations; general cerebral hyperæmia and œdema.

CASE LXVI.—Patient jumped from the third tier of the Tombs prison to the flagging below; various signs of intracranial injury but no muscular disorders until the sixth day when all the extremities became paretic, most markedly on the right side, with impaired sensation; some right facial paralysis two days later; general paralysis continued until death on the sixteenth day.

Lesions.—Fracture extending from left squamous portion of temporal bone along anterior surface of petrous portion into optic foramen; slight lacerations of right temporal lobe with cortical hemorrhage extending from occipital lobe forward and barely reaching to motor area; intense cerebral hyperæmia; excessive cerebral œdema, serum following the knife on section; ventricles distended.

The first and second of these cases are readily explicable by a possible flow of blood from the posterior basal fossæ into the spinal canal, and the third by a compression of both motor areæ by a pial hemorrhage. The other three are less readily comprehensible. One motor area only was compressed in the fourth and fifth cases; and in the sixth, as well as in the fourth and fifth, cerebral œdema was excessive.

Paraplegia.—The instances of paraplegia were but three in number, and the only one which was fatal afforded upon necropsy no positive results. Death occurred five minutes after admission to the hospital. The lesions were: Fracture extending from left posterior parietal region into the anterior

and middle basal fossæ; epidural hemorrhage, still fluid, extent not noted; slight hemorrhagic extravasations into the meshes of the pia mater; and slight lacerations of the inferior surface of the left temporal and frontal lobes.

The cases of recovery were:

CASE LXVII.—Trifling scalp wound in left mid-parietal region near the median line with a large hæmatoma, variously accounted for by the patient who was sure he had been struck, but was uncertain whether by a railroad bridge, or by a bootblack; complete paraplegia the only general symptom; reflexes slightly exaggerated; muscles flaccid; no previous paralysis; no history of syphilis; treated with potassium iodide. He was able to walk fairly well after one week.

CASE LXVIII.—Patient six years of age had been struck by a box falling from a distance; unconscious; compound fracture of vertex with epidural hemorrhage; paraplegia on the fifth day. Sensation unimpaired; reflexes normal; highest temperature 100.2°; he could walk a little with support on the forty-fifth day.

Paralysis of One Lower Extremity.—Necropsy was had in both the two cases noted. In one of these, patches of lymph were deposited over both margins of the median fissure, and may perhaps afford adequate explanation of the paralysis which occurred on the fifteenth day after injury: in the other case, one in which there was paralysis of the left lower extremity, the lesions were: Fracture extending from the left squamous portion through the left middle and both anterior basal fossæ; a large epidural clot in the left middle fossa, and a general cerebral contusion.

Paralysis of the Upper Extremities.—While the instances of a paralysis confined to one or both the upper extremities were more frequent than paralysis of a single lower extremity, their percentage was still small. They were 24 in all, of which 10 were fatal and 6 were subjected to a post-mortem examination. They were primary or secondary in equal number, and were oftener incomplete than complete. They were of both transient and permanent duration and were variously complicated or uncomplicated by disorders or losses of sensation

The lesions noted at necropsy were:

1. Primary paralysis and anæsthesia of the left upper extremity—preceded by convulsive movements for five minutes.

Epidural and cortical hemorrhage over whole left hemisphere; cortical hemorrhage over right motor area; marked cerebral hyperæmia; extensive lacerations of right frontal and temporal lobes.

2. Paralysis of right upper extremity on the fourth day.

Epidural clot compressing and flattening the whole left hemisphere; laceration of the left temporal lobe; lateral ventricles distended with serum, each to the amount of two ounces; and *iter e tertio ad quartum ventriculum* distended to size of goose quill; small hemorrhage in floor of fourth ventricle.

3. Paralysis of left upper extremity on the second, day.

Large cortical hemorrhage over right temporal lobe, and in thick clot over upper part of fissure of Rolando; general cerebral hyperæmia with minute thromboses; thrombus in lateral sinus.

4. Primary paralysis of right upper extremity preceded by anæsthesia; both disappeared within twenty-four hours.

Moderate subarachnoid effusion; subcortical excavation of whole left frontal lobe with blood breaking into the lateral ventricle; subcortical excavation of right frontal lobe with blood breaking through the cortex; deep laceration of posterior border of the cerebellum, brain hyperæmic and œdematous; minute vessels filled with coagula.

5. Paralysis of right upper extremity on second day, with rigidity of both arms and right leg.

Epidural clot compressing left hemisphere and extending from Sylvian to median fissure; entire brain excessively hyperæmic.

6. Paralysis of right upper extremity on the ninth day preceded by general muscular rigidity and convulsions, and accompanied by slight right facial paresis.

Large arachnoid serous effusion; thin pial hemorrhage covering both parietal and both occipital lobes; small lacera-

tions of right frontal and left occipital lobes; general cerebral hyperæmia and œdema, with minute thromboses, punctate extravasations, and serous fluid in left lateral ventricle.

In each instance but one, and possibly in that one the motor area of the opposite side was covered by blood or a serous effusion; but the amount of pressure exerted, or its sufficiency as the cause of the paralysis is uncertain.

Hemiplegia.—Cases of hemiplegia were usually complicated by other muscular disorders. These were:

	In fatal cases	In recovering cases
Convulsions	7	4
Facial paralysis	10	8
Convulsive movements	10	3
Muscular rigidity	8	5
No muscular complications	9	4
	44	24

The accessory muscular disorders were general, or were limited to either the hemiplegic or opposite side, and were in varying degrees prominent in the history of the case.

The hemiplegia which, as in idiopathic cases, might be either suddenly or progressively developed and might be either a complete or an incomplete loss of muscular power, was primary in 27 fatal, and in 12 recovering cases; and was secondary in 17 of those which were fatal and in 12 of those which recovered.

Anæsthesia was concurrent in 7 fatal and in 2 recovering cases.

Destruction of the optic thalamus was undoubtedly responsible for the occurrence of hemiplegia in 2 cases, and compression of the motor area by blood or inflammatory exudation seems adequate explanation in 10 others of the 27 in which post-mortem examination was made. In 6 of the cases remaining a similar compression was possible; in 3 the notes of necropsy were deficient; and in 6 no gross lesions of the motor area or motor tract existed.

The lesions in the cases last mentioned were:

1. Right primary hemiplegia. Laceration of external border of right cerebellar lobe with cortical hemorrhage about the circle of Willis, upon the anterior portion of the pons and in the transverse fissure; hemorrhage (apoplectic) in the left lateral ventricle, breaking into the right ventricle and into the left occipital lobe which it completely excavated.

2. Left secondary hemiplegia. Subarachnoid serous effusion limited to frontal regions; excessive cerebral hyperæmia with minute thromboses.

3. Left secondary hemiplegia. Excessive meningeal and cerebral hyperæmia with minute thromboses.

4. Left primary hemiplegia. Cortical hemorrhage over left hemisphere from laceration in posterior parietal region.

5. Left primary hemiplegia. Pial hemorrhage in posterior basal fossæ and in right lateral ventricle.

6. Left primary hemiplegia. Pial hemorrhage over left hemisphere; subcortical laceration of right posterior inferior portion of parietal lobe, and of first and second right temporal convolutions, from which blood had escaped into the right ventricle.

Facial Paralysis.—Facial paralysis was somewhat less frequently complicated by other muscular disorders than hemiplegia; but was equally varied in its manifestations. It was fatal or recovering, and was primary or secondary in nearly equal proportions. It was variably general, or confined to either the upper or lower face area, was transient or permanent, was slight or complete, and was as devoid of special peculiarities as are all other forms of traumatic paralysis. It was associated with general paralysis in 1 case, with general convulsions in 11, with hemiplegia in 11, and with paralysis of an upper extremity in 7 cases. It was double in only 2 instances, and was not often accompanied by simple convulsive movements.

Necropsy was had in 18 of the 30 fatalities, but in 2 the notes are missing. In 6 of the remaining 16 cases there were other paralyses in connection with which they have been given consideration. In 3 of the final 10 cases in which paralysis

was facial alone there were no gross lesions of the face centre, motor tract, or facial nerve.

The lesions noted in these cases were:

1. Incomplete right facial paralysis. Epidural hemorrhage in right midfrontal region in an area of about 2 x 3½ inches; cortical laceration of inferior surface of both prefrontal lobes and of left temporal lobe; marked general hyperæmia, especially of the cortex, and moderate œdema.

2. Right facial paralysis. Epidural hemorrhage in right parietal and occipital regions; cortical hemorrhage in both superior occipital regions; both hemorrhages in moderate amount; laceration of inferior surface of both frontal lobes anteriorly; brain excessively hyperæmic and œdematous.

3. Right lower facial paralysis, manifested on the sixth day. Small epidural hemorrhage limited to left prefrontal region; laceration of inferior surface of both frontal lobes, mainly subcortical; general cerebral hyperæmia, with minute thrombosis, especially in the occipital region.

The frequency of injuries of the temporal lobe is as noticeable in case of the various paralyses as it was in case of muscular rigidity and convulsive movements already mentioned. In the several instances of serious lesions of an optic thalamus it is perhaps probable that the inner capsule was involved.

Disorders of the Ocular Muscles.—These occurred in about equal number in fatal and in recovering cases. They included exophthalmos, convulsive movements, conjugate deviation, general paralysis of the ocular muscles, ptosis and strabismus. They were noted in 15 cases. These were:

1. Four cases of exophthalmos, 3 with fracture through both anterior fossæ and hemorrhage into the orbit, and 1 without fracture, which was slight and unilateral, with ecchymosis of the upper lid and a large hæmatoma in the temporal region of the corresponding side.

2. Two cases of convulsive movements; 1 occurring in articulo mortis, following general convulsions, and the other paroxysmal, confined to one eye, and accompanied by convulsive movements of the upper extremity of the same side.

There was nothing to suggest that these differed from those cases marked by similar movements in other limited groups of muscles. The obvious essential lesion in one instance was an epidural hemorrhage, and in the second, a special hyperæmia of one optic thalamus.

3. Six cases of conjugate deviation. The muscular conditions and lesions in these cases were:

a. Eyes turned upward and to the right; on the second day slight convergent strabismus. *Lesions:* Dura mater greatly congested in its posterior two thirds; longitudinal sinus containing white clots in its anterior half, and in its posterior half filled with red coagulum; acute arachnitis with seropurulent effusion at the vertex and thick pus at the base; fracture through middle and posterior basal fossæ.

b. Eyes turned to right and fixed in tonic spasm; later, spasmodic contractions of various groups of muscles. *Lesions:* Large epidural hemorrhage from rupture of the sigmoid sinus; pial hemorrhage over right parietal lobe extending from fissure of Sylvius upward; contusion of third left temporal convolution; linear fracture, 8 inches long, immediately in front of coronal suture, with depressed fragment 1½ inches square, involving both right frontal and right parietal bone; comminuted fracture at left parieto-occipto-squamous junction with fissures extending into middle and posterior fossæ and intervening petrous portion.

c. Eyes turned to right; slight general convulsive movements. *Lesions:* No lacerations or intracranial hemorrhages; moderate subarachnoid serous effusion in right parietal region; purulent effusion in moderate amount over anterior border of the pons, posterior border of the cerebellum, and posterior portion of the inferior cerebellar surface; cortical contusion, 3 x 2½ inches in extent, embracing middle portion of first left temporal convolution and adjacent parietal surface; excessive cerebral hyperæmia and œdema with serous effusion in the lateral ventricles; fracture extending through petrous portion into right middle and posterior fossæ.

d. Head and eyes turned to the right; convulsive move-

ments of left angle of mouth, and of right hand and arm. *Lesions:* No fracture; no lacerations; pial hemorrhage covering whole brain except frontal lobe; thickest in right middle and posterior parietal regions; was both above and below the tentorium; general cerebral hyperæmia and œdema.

c. Head and eyes turned to the right; left facial paralysis; slight twitching of the fingers of the right hand. *Lesions:* Inconsiderable pial hemorrhage over left fissure of Rolando; laceration of whole lateral surface of right temporal lobe, except at its tips, and of a narrow margin of its periphery; cortical hemorrhage which escaped through a wound in the dura mater and formed an epidural hemorrhage over the right temporal and posterior part of the right frontal lobe; cerebral thrombi and punctate extravasations; diastasis of left corneal suture.

f. Head and eyes turned to the left; left hemiplegia. *Lesions:* "Hemorrhage into the ventricle and around the bulb"—(Note made by coroner).

g. Head and eyes turned to the right; left hemiplegia. *Lesions:* Small epidural hemorrhage—about one drachm—in right middle fossa; subarachnoid serous effusion; general cerebral hyperæmia and œdema.

These post-mortem findings differ from those found in the more frequently reported cases of idiopathic origin. Those have been almost if not quite invariably gross structural changes in the brain tissue, the result of softening, cerebral hemorrhage, or morbid growth. These, so far as they were cortical or subcortical, were generally the hyperæmia and œdema common to all intracranial injuries. The more obvious lesions were superficial, the meningeal hemorrhages and inflammatory effusions. There were 2 cases of limited contusion of a single temporal convolution and 1 of a wide laceration of a temporal lobe; neither of these encroached upon the recognized motor centres for the head and eyes; and it is doubtful if those centres were compressed by either of the superficial hemorrhages or effusions.

4. One case of ptosis; accompanied partial loss of vision

in the corresponding eye and total loss in the other; and resulted from a gunshot wound in which the ball passed between the periosteum and orbital plates. (Other cases were included in facial paralysis.)

5. One case of strabismus; accompanied general, including double facial paralysis. (See General Paralysis.)

General paralysis of the ocular muscles was only observed in recovering cases. These were three in number.

CASE LXIX.—*Fracture of the cranial base,* followed by a purulent discharge from the right ear and symptoms of arachnitis; no injury in orbital regions; left pupil continuously more or less widely dilated and irresponsive paralysis of all the muscles of the left eye, and paresis of those of the right; left facial paralysis.

CASE LXX.—Patient fell down stairs headforemost; profuse epitaxis; much ecchymosis of both upper eyelids; pupils normal; diminished facial sensibility. Eight hours later, intense headache and diplopia. Fifth day: Exophthalmos of left eye, from paralysis of all the ocular muscles; optic neuritis in both eyes; impaired sensation in the course of distribution of the first and second divisions of the fifth nerve on the left side. Headache and diplopia disappeared in a week's time.

A third case is detailed in another connection.

A very large number of cases of paralysis have been cited in order that the correctness of the conclusions which they suggest may approach a mathematical demonstration.

An examination of the lesions of all forms of paralysis has shown a certain number of cases of unmistakable compression of the motor area or laceration of the motor track. It has also shown many others in which such injuries seem probable, as well as a still greater number in which they may have been possible. There has remained a considerable number of cases in which no focal lesion is apparent, and of which the interpretation must be in some degree conjectural. The lesion in these cases must be by exclusion a general lesion and therefore necessarily a contusion of the brain substance. The primary result of cerebral contusion as already noted is an

anæmia followed by a hyperæmia from which, it has been demonstrated, there result nutritive changes indicated by œdema and cellular degeneration. In view of these pathological facts it is not difficult to understand the occurrence of a loss, impairment, or disorder of muscular function even in the absence of gross lesion of the motor centres. Nerve fibres or nerve cells may suffer either from the intracerebral pressure of distended veins or serous transudation, or from the degenerative processes.

While in the many instances in which the indirect pressure of an inconsiderable epidural hemorrhage, or the more direct pressure of a thin pial or cortical hemorrhage or moderate subarachnoid effusion, exerted upon the motor area may conceivably occasion a concurrent paralysis, it still seems more reasonable to suppose that as in the cases in which no such conditions exist it is independent of the superficial lesion.

It is difficult to explain the limitation of paralysis to a single extremity or to individual muscles when the whole cerebrum is laterally compressed by a large epidural hemorrhage, or when the whole motor area is uniformly covered by a subarachnoid effusion. It becomes more comprehensible, however, upon the supposition that the superficial pressure primarily affects the cerebrum as a whole; and that a resulting irregular general circulatory derangement and degenerative nutritive changes have a local manifestation in the corresponding cells or projection fibres.

Ataxia.—There was only one instance of ataxia noted; this was of the motor form and was in a case terminating in recovery. The patient, who had fallen from a truck and struck upon the back of his head, was primarily delirious and afterward slow of comprehension. He suffered much from occipital headache, and ocular examination disclosed advanced optic neuritis in the right eye with slight paralysis of the external rectus muscle. His temperature did not exceed 101° and his respiration was 12 in the minute for three days, 8 again for six days, and then 8 to 12 for two weeks with normal temperature. He was out of bed at the end of the third week.

but walked with difficulty on account of muscular inco-ordination equally marked in both legs. The patellar reflexes were normal. He had no other symptoms except slight vertigo and some slowness of comprehension.

In one instance also there was some lack of co-ordination in the finger muscles. In this case there was a superficial parietal abscess just posterior to the motor area, and a general acute arachnitis.

Disorders of the Cutaneous, and Muscular or Tendinous Reflexes.—These disorders have no diagnostic importance. They were noted in about 15 per cent. of cases, and would probably have been found in much larger proportion if they had been sought in all cases, not only primarily, but throughout their progress. They occurred in the various modifications of normal conditions observed under other circumstances, and were not apparently influenced by concurrent symptoms, nor dependent upon the nature of attendant lesions. An analysis of 32 cases with necropsy occurring in the last 300 of the series afforded results which may be considered representative of all such cases.

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Reflexes Increased  ..................................... 10
    Patient  unconscious  .............................. 6
    Patient  conscious  ................................ 3
    Patient  delirious  ................................ 1
    Concurrent  muscular  disorders..................... 6

Reflexes Absent  ....................................... 16
    Patient  unconscious  .............................. 12
    Patient  conscious  ................................ 3
    Patient  delirious  ................................ 1
    Concurrent  muscular  disorders..................... 8

Reflexes Unsymmetrical  ................................ 6
    Patient  unconscious  .............................. 3
    Patient  conscious  ................................ 2
    Patient  delirious  ................................ 1
    Concurrent  muscular  disorders..................... 2
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It may be noted that neither the mental nor the general muscular condition greatly affected the nature of the reflex

disorders. The muscles were rigid, convulsed or paralyzed, and the patient conscious or unconscious, in about the same proportion of cases whether the reflexes were lost or increased. They were paralyzed in only 5 instances, 1 of the face and 4 of hemiplegia.

The most careful examination post mortem fails to disclose any definite relation between evident lesions and the reflex phenomena. Large cortical and meningeal hemorrhages were rather disproportionately frequent; but meningeal contusion or inflammation, and subcortical without superficial lesion were also encountered; and all of these without reference to the particular reflex condition. The motor tract or area was not often specifically involved.

IX. FOCAL SYMPTOMS.—Focal symptoms are referable to lesions of cranial nerves or of cerebral centres of control.

Cranial Nerves.—Such symptoms may be occasioned by lesion of the nerve at its origin, in its intracranial course, or at its cranial exit; and are manifested in functional loss or derangement.

Lesions of the olfactory nerve or bulb, or of its central origin occurred in nine cases, in all of which with possibly a single exception in which the method of examination is not stated, the effect of simple sensory irritation was carefully excluded. In each case but one the cranial base was fractured, and in all save one the patient recovered; but the special sense was not restored in either while under observation. In four cases the left frontal lobe was also injured.

CASES.

CASE LXXI.—The patient lived one week after having been assaulted, all the time delirious and incapable of exhibiting subjective symptoms.

Lesions.—No epidural hemorrhage or meningeal effusion; extreme meningeal and cerebral contusion; laceration of left frontal lobe; right olfactory bulb disintegrated and involved in cortical clot; left bulb distended by internal hemorrhage.

CASE LXXII.—Gunshot wound through right temporal fossa;

primary loss of the special senses of sight and smell; progressive exophthalmos. The eye was removed on the fifteenth day and the bullet found in the inferior portion of the right frontal lobe; middle basal fossa and orbital wall comminuted.

CASE LXXIII.—The patient was thrown from a high cart and struck the ground upon the back of her head. She was primarily unconscious, and suffered a contusion of the right occipital region attended by severe localized pain and mastoid ecchymosis. Hearing was disordered until the fourth week. The special senses of smell and taste were primarily impaired and two years later were unimproved.

CASE LXXIV.—A physician in a railway accident received a contusion of the right parietal region. Two days later symptoms appeared which still persisted after the lapse of several years. They were: dilatation of the left pupil with incomplete paralysis of all the left ocular muscles and levator of the upper eyelid; anæsthesia of the conjunctiva of the left eye and mucous membrane of the left nostril; complete loss of the sense of smell in the same nostril; excessive pain on the left side of the head and face in the course of distribution of all the branches of the fifth nerve.

Loss of sight so far as it depends upon implication of the optic nerve in a line of fracture through the optic foramen was noted in connection with the symptomatology of fracture; and some account given of the six cases observed. In a seventh case the loss of sight was evidently from intracranial injury, either of the optic nerve or in the course of the optic tract. The loss was not discovered until the fifth day and was temporary. The pupils were symmetrical and the optic disc was practically normal.

The paralysis and disorders of the ocular muscles from lesions of the third, fourth and sixth nerves, or of the brain itself, were described and illustrated in the consideration of muscular disorders in general. A case not cited in that connection is noted for the strict confinement of lesions to these nerves.

CASE LXXV.—A man while dancing fell backward, striking his head upon the ballroom floor. He had no symptom of injury

except a slight headache for thirty minutes. His right eyelid then began to droop, and ptosis was soon complete. Examination was made five hours later. There was no wound or evident contusion; ptosis of the right eye was still complete with external strabismus; there was also incomplete paralysis of all the right ocular muscles, diplopia and imperfect accommodation. The pupils and retina were normal, and there were no other symptoms then or thereafter.

Although some degree of facial paralysis is of frequent occurrence, its dependence upon lesions of the facial nerve is not often demonstrable. In one case only of the present series there was obvious compression of the nerve in its osseous course of exit; in this the bone was comminuted and the aqueductus Fallopii filled with clot. Fractures of the petrous portion are usually simple fissures without displacement; and facial like ocular paralysis seem to be the result of central lesion.

There was no instance in which disturbance of function of the fifth nerve was an independent focal symptom. In two cases of anosmia the sense of taste was lost or impaired, and in a third pain persisted in the course of distribution of its sensitive fibres. There was no case in which the muscles of mastication were affected, and very few in which facial paralysis was accompanied by anæsthesia.

Deafness resulted in many of the cases in which fracture through the petrous portion was attended by hemorrhage from the ear. It was doubtless often due to rupture of the tympanum and obstruction of the auditory canal; but in a certain number of cases it is fair to assume that the distribution of the auditory nerve was the seat of destructive injury.

Vertigo was a symptom in many cases of intracranial traumatism, and in the absence of probable basal fracture, especially when following profuse external hemorrhage from the ear or in conjunction with manifest evidence of cerebral contusion, should be regarded as a general rather than a focal symptom. If, on the other hand, vertigo is closely associated with an aural hemorrhage or serous discharge indicative of basal fracture, as happened in many cases, and the onset of

circulation apparently is not greatly disturbed, it would seem
that local injury of the auditory nerve should equally be re-
garded as its efficient cause. Two cases will serve to illus-
trate this probable relation of vertigo to nerve injury.

CASE LXXVI.—A man fell from a truck upon the back of his
head. There was hemorrhage from the right ear which continued
for twenty-four hours; headache, deafness, vertigo, and mastoid
ecchymosis, together with the impairment of the special senses
of taste and smell, which persisted for two weeks. Pulse and
temperature were normal from the time of first observation on
the tenth day and there were no general symptoms.

CASE LXXVII.—A man while sleeping fell from a third-story
window. On immediate admission to the hospital there was
profuse serous discharge from the ear and severe vertigo aggra-
vated by rising in bed or opening his eyes. The pulse was normal
in force and frequency. On the eighth and ninth days he had
epileptiform convulsions; and on the twentieth he began to have
an inflammation of the mastoid region for which he was trephined
with negative result. The temperature but once exceeded 99°.

Dysphagia was observed in 17 cases of which 13 were
fatal. It was usually an incomplete paralysis, and in fatal
cases was permanent. It was both an early and a late symp-
tom, and in many instances was variable from day to day.
Articulation as well as deglutition was difficult in 6 cases, and
in a seventh it was alone affected. In 4 cases, 3 of meningeal
effusion and 1 of pial hemorrhage into the basal fossa, there
was no other assignable cause apparent for the dysphagia or
aphonia than compression of the nerves which supply the lin-
gual and pharyngeal muscles. In the 5 cases remaining the
sole or essential gross lesion was in each a cerebral contusion;
and in these it seems necessary to assume a lesion of the cere-
bral centre or centres of control. This view is strengthened
by the fact that in 3 of the fatal, and in all of the recovering
cases, there was evident lesion of the left frontal lobe which is
adjacent to the controlling centres of these muscles.

The following cases are representative of the two forms
of pharyngeal paresis.

CASE LXXVIII.—The patient from the fourth day was delirious in varying degree till her death ten days later. There was difficulty in deglutition at intervals from the seventh day, and just before death dyspnœa and dysphagia were extreme.

Lesions.—Fracture through left occipital fossæ, extensive laceration of inferior surface of left frontal lobe, and all the basal fossæ filled with cortical clot; thin pial hemorrhage over entire left, and posterior half of the right hemisphere.

CASE LXXIX.—Protracted hemorrhage and serous discharge from the ear; bronchitis which developed on the fifth day and began to subside on the seventh. No symptoms referable to intracranial injury were noted till the eleventh day, when there was occipital pain and rising temperature, followed by somnolence, continued rise of temperature to 104°, and rigidity of the cervical muscles. Still later there was active delirium and deafness. From the twenty-fifth to the thirtieth days hearing and articulation were wholly lost, the patient could communicate only by gesture. Dysphagia occurred somewhat suddenly, a little later than the aphonia. Death occurred on the forty-first day, following progressive emaciation, paralysis and anæsthesia of the left lower extremity, and loss of rectal and vesical control.

Lesions.—Fracture through outer portion of right petrous bone; no intracranial hemorrhages or cortical lacerations: thrombus in each lateral sinus from the torcular Herophili into the jugular foramen; patches of lymph upon the vertex; several ounces of turbid serum in the basal fossæ, and a membranous exudation covering the pons and inferior cerebellar surface; large serous effusion in the lateral ventricles.

CASE LXXX.—The patient on admission to the hospital was unconscious, and later rational with slow cerebration. On the second day there was some dysphagia referred to the left side of the pharynx, and a barely perceptible left hemiplegia which was progressive but always slight and variable in degree. On the seventh day there was a very slight facial paralysis with loss of rectal and vesical control. Dysphagia continued till death from asthenia on the twenty-eighth day.

Lesions.—No fracture; no intracranial hemorrhage; no cerebral laceration; large subarachnoid serous effusion in the frontal region; excessive hyperæmia of the cerebrum with minute vessels everywhere filled with coagula.

CASE LXXXI.—The patient's condition until the sixteenth day was characterized by stupor and increasing mental disturbance with moderate temperature. His speech then began to be thick and difficult to understand. Rectal and vesical control was lost, and he had delusions but was otherwise rational. His speech grew more difficult, and on the twenty-fifth day he had dysphagia. He died three days later, his temperature having risen to 109.4°; and was 109.6° forty-five minutes post mortem.

Lesions.—Fracture through right middle fossa; no intracranial hemorrhage; moderate subarachnoid serous effusion; marked left frontal atrophy; entire brain substance, including cerebellum and basal ganglia, hyperæmic and œdematous to an excessive degree.

Reference has been made to cyanosis and pulmonary œdema from compression of the pneumogastric nerve as a disorder of respiration. As a distinctive symptom the two conditions must concur. It is of only occasional occurrence, and is not usually associated with that compression of the respiratory ganglia which has been described, but is even more uniformly fatal. The compressing agent is blood derived from a pial or cortical hemorrhage into the posterior basal fossæ. The pressure exerted by an epidural extravasation is insufficient to inhibit function by reason of the intervention of the dura mater.

CASE LXXXII.—The patient was found helpless in the street and unable to speak. His limbs were flexed and his muscles spastic. The left pupil was dilated, and neither pupil reacted to light or accommodation. There was slight mastoid ecchymosis. No disturbance of respiration; temperature 98°; pulse 120; respiration 24. On the third day the patient, previously quiet and apathetic, became restless, and soon afterward cyanotic with pulmonary œdema.

Lesions.—Two cranial fissures in inferior occipital fossa: one through groove for lateral sinus into the jugular foramen, the other into the foramen magnum; no epidural or pial hemorrhage; extensive laceration of inner border of cerebellar lobe; cortical hemorrhage in inferior occipital fossa.

Lingual paralysis was noticeable in but two instances; in

one it persisted until the patient was discharged from the hospital, and in the other until his death. The first was unaccompanied by other paralysis, the second by facial paralysis and ptosis. It is probable also that in cases of dysphagia or aphonia the lingual muscles may have been in some degree involved.

It is evident from this summary of cases that in functional loss or derangement of parts to which cranial nerves are distributed these nerves are not necessarily at fault. The only focal symptom which is invariably chargeable to lesion of a cranial nerve is the cyanosis and pulmonary œdema which has been described. Diagnosis may be positive in one other condition. The implication of an optic nerve in a line of fracture through the optic foramen may be determined by ophthalmoscopic examination; with this exception the seat of lesion, whether of the nerve or cerebral centre, can be inferred only from the history of the case and the associated symptoms; and with how great a degree of certainty this can be done may be estimated from a study of the various histories which have been cited.

Cerebral Centres of Control.—A number of instances in which symptoms are occasioned by lesions of definite centres of control have been already noted. They include retardation and stoppage of respiration from compression of the respiratory ganglia, certain cases of paralysis from lesions of the motor area, and certain other cases of loss or impairment of the special senses of sight, smell and taste and loss of power in the muscles of the eye, tongue and pharynx. There remain mental derangement, exclusive of acute mania or delirium, and aphasia.

Mental Derangement.—The fatal cases in this series which were marked by distinctive symptoms of intellectual and emotional disturbances were cited in two monographs relating to localization of the mental faculties in the left prefrontal lobes.[*]

[*] Phelps, American Journal of Medical Sciences, April, May, June, March, 1906.

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[19] Phelps, American Journal of Medical Sciences, April–May, 1902; March, 1906.

They were supplemented by a certain number of cases terminating in recovery, and the subject was fully discussed and various considerations presented which substantiated a belief in the actuality of such a localization. It will be unnecessary therefore to do more than to reiterate the statement of conclusions then reached, and to reproduce from those publications two well marked antithetical cases; one of lesions of the left frontal, and one of the right frontal lobe. Those conclusions were:

1. Mental decadence always attends conjoint lesion of both prefrontal regions.

2. Mental decadence always attends lesion confined to the left prefrontal region.

3. Mental decadence never attends lesion confined to the right prefrontal region.

These postulates were based primarily upon a study of the cases proper to this series, and their correctness was confirmed by the records of other reported cases of traumatisms, abscesses, tumors and congenital defects, as well as by results of experimentation. The histories of all the original cases, 29 in number, were detailed, and while some were conclusive, none were contradictory and the greater number were convincing, as were those reported by other writers by whom these facts had not been recognized. If by chance exceptional cases should be encountered, which are inconsistent with the belief in the existence of such a localizing region, they need not be regarded as necessarily invalidating the results of positive clinical and post-mortem observation. It should be borne in mind that functional anomalies are often explicable by anomalies of cerebral structure; that, e.g., the lesion has more than once been found to be upon the same side with a hemiplegia, and that the removal of the entire left temporal lobe was followed only by temporary right hemiplegia and doubtful hemianopsia; and that the observation of a single case led Trousseau to deny the truth of Broca's discovery. If the same nature and degree of proof which is deemed sufficient to establish centres for the localization of other cerebral functions may

be accepted for the mental faculties, their centre of control has been established.

This localization, as it was stated, is simply one of topography and has no reference to the nature of the control exercised, whether one of co-ordination or of inhibition, or to the psychological theories of various authors. The fact that mentation has an anatomical substratum having been accepted as an almost axiomatic truth, it only remained to determine whether this physical basis was more or less precisely delimited or was generally diffused in the cerebrum.

CASE LXXXIII (Abstracted from Case LX in Monograph of 1902).—The patient was primarily unconscious and in shock with widely dilated and irresponsive pupils; compound comminuted depressed fracture extending through the inferior portion of left parietal bone from coronal suture to mastoid process; much brain matter extruded and lost. The disintegrated brain area involved at least the posterior half of left frontal and upper part of left temporal lobe; just how much farther this area extended anteriorly and inferiorly could not be accurately determined without unjustifiable exploration. *On regaining consciousness the patient muttered and laughed for fifteen minutes*; on the second day he was irritable and irrational but not delirious; on the third day his speech was mere gibberish and he laughed and cried at intervals; on the seventh day he could understand English but could not speak it; in the second week he was actively delirious; in the third week he could speak a few words of English, was very emotional, and wore a peculiar fatuous smile. Before his injury he usually spoke in the Norwegian language; when he regained speech it. was English only; his Norwegian vocabulary was afterward limited to a few words. At the end of three months he said if he were to return to work he would be unable to comprehend orders. He was still emotional and cried often, though his wife stated she had never heard him cry before he was injured; he had various manifestations of aphasia; *his power of attention began to improve though his mental faculties were generally weakened.* His symptoms, with the exception of long-continued dilatation and inaction of the pupils, were at all times confined to disorders of the mind and speech.

CASE LXXXIV (Case VII of Monograph of 1906).—The patient was made primarily unconscious but walked several miles to a hospital. On admission he was very weak and somewhat apathetic but his mental condition was normal. On the following day some osseous fragments were removed from the right orbit and a cerebral cavity as large as an egg disclosed which had been formed by destruction of the anterior portion of the first, second, and third right orbital convolutions. There were no subsequent mental symptoms, and none of importance physically except some rise in temperature.

The following is illustrative of that class of cases with recovery in which left frontal lesion has been assumed to exist.

CASE LXXXV.—The patient, who had no history of alcoholism, was primarily unconscious. On admission to the hospital he was still unconscious with normal pulse and temperature. He had a contusion of the right side of the head and neck, but no hemorrhage from the ear. He had also left facial paralysis and loss of vesical control; temperature on the third day rose to 102°. On the fourth day he could be aroused, and seemed vaguely conscious of what was said to him; he was emotional, his left leg and arm movements were unsteady, and reflexes on the left side were slightly exaggerated. On the eighth day he was able to sit up and talk rationally for two or three minutes at a time, but then became erratic. In the fourth week his facial paralysis had disappeared, the use of the left arm was normal, but the left lower extremity was still paretic. He was coherent but irrational and answered questions with a peculiar grin. He said variously that when improved he was going to the morgue, that he was going to some village (named), in Germany; that he was accompanied by seven men or by some other number which was variable; that he was in Bellevue learning to be an inspector of farms; and usually believed that he was in Germany.

At the time of his discharge from the hospital in the second month his mental condition was apparently normal.

There is often a single fixed delusion which is persistent, though perhaps accompanied by others which are transitory

and variable, as in the case just cited; or as in Case LII of the collection of cases to which reference has heretofore been made,[20] in which a longshoreman who had fallen from a ship's deck was quite certain up to the time of his death, twenty-four days later, that he had fallen from a mulberry tree in Fordham; and described the occurrence with great and unvarying circumstantiality of detail. This case, which was one of laceration of both frontal lobes, escaped inclusion in the series of frontal lesions which it would have increased to thirty. The delusion as in these cases is perhaps most often one of locality. It may, however, be one of an entirely different nature as in Case CCLXXVIII of the same collection.[21] This patient suffered acute anguish for some weeks on account of the fancied death of his wife, and for many weeks afterward on account of the death of a child. He had never had either wife or child, as the other man had probably never seen either Fordham or a mulberry tree. The persistent delusion is sometimes unaccompanied by others, and may be of singular character; as in case of the hobo who had probably never worked in his life, and was honestly anxious to leave the hospital that he might get back to his work; or the man who confounded the sexes and thought every man he saw was a woman, and every woman a man.

The mental derangements which result from cerebral traumatism do not exactly correspond to any form of mental disease included in the nomenclature of the alienists, but the term traumatic dementia which has been sometimes used sufficiently serves the purpose.

Aphasia.—There were 30 cases in which aphasia was a symptom, 24 of which terminated in recovery.

It is perhaps a matter of interest rather than of importance that in 28 instances the subjects were males; and it is probable even that one of the two female subjects became aphasic from an apoplectic seizure rather than from the traumatism, since

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[20] Traumatic Injuries of the Brain.
[21] _Lib. cit._

a week had elapsed from the time of injury without interven-
ing symptoms; and the later loss of speech was attended by
the usual symptoms of that form of cerebral hemorrhage.
The accident or influence of sex parallels the sex condition in
traumatic convulsions, in which 101 out of 110 patients were
males; but while the greater frequency of convulsions in man
may be explicable upon the supposition of a sexual difference
in reaction to a general irritation, it is inconceivable that sex
should affect the result of a structural injury of a cerebral
centre. If males are more liable than females to suffer trau-
matic aphasia it can only be ascribed to a greater general
exposure to intracranial injuries.

There were certain attendant symptomatic conditions so
often present as to be in a measure characteristic. These were
in frequency and in detail:

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Muscular  disorders  ..................................... 27
Paralyses  ............................................... 18
Convulsions  ............................................  4
Muscular  rigidity  .....................................  5
                                                         ——
                                                         27


Mental disorders distinctive of left prefrontal lesion...... 13
Loss of impairment of special senses................. 4
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Six of the paralyses were hemiplegias, and the remainder
were of the face, pharynx, or upper extremity.

The frequency of these concomitant symptoms is quite
comprehensible in view of the propinquity of corresponding
centres of control to those of speech. The area in which all
these centres are localized, the frontal and temporal convolu-
tions, in the island of Reil, and the margin of the Sylvian and
Rolandic fissures, is so limited that the usual comprehension
of two or more of them in a common lesion seems almost inev-
itable. In a majority of cases two or more centres were
involved, not only associating different forms of aphasia with
each other, but with one or more paralyses or with functional
loss or impairment of special senses. The right hemiplegia

which has been accounted a specially characteristic complication of aphasia was noted in only 6 cases, and paralysis limited to the right upper extremity in 3 others. There was in one instance the exceptional occurrence of paralysis of a corresponding extremity. The history of this case is appended. The paralyses were usually incomplete and often transient.

The general symptoms were as varied as in cases of cerebral injury in which the disturbance of speech was absent; and in some instances no general symptoms were observed. No complicating symptoms, aside from those which were mentioned as allied through community of lesion, was characteristic. As with other intracranial lesions that of the speech centres occurred with and without cranial fracture. There were 18 cases with fractured base, 4 with fractured vertex, and 8 in which no fracture had been sustained. The several forms of aphasia as they may co-exist in a given case cannot always be recognized on account of the concurrence of stupor or delirium, or as it sometimes happens because the patient speaks only in some unusual dialect for which no intelligent interpreter is obtainable. Their classification in the present series of cases so far as it was possible to be determined was:

Motor Aphasia 7
Sensory Aphasia 4
Sensory Motor 14

Motor aphasia was noted in 5 other cases in which the pressure or absence of sensory disturbance could not be ascertained on account of a condition of delirium or dementia or by reason of an unintelligible dialect. The varied forms of aphasia, motor, auditory and visual including paraphasia and agraphia, were all represented in this series. Their manifestations, however, were not different from those which have been described in other reported cases.

The aphasic condition was undoubtedly primary in 11 cases, and secondary in 5; positive knowledge of the time of its occurrence in the remaining 14 was wanting on account of the persistence of early unconsciousness, delirium, or stupor, or

the lack of history prior to a late admission to the hospital. When known to be secondary it was first apparent from the second to the twelfth day; and in the doubtful cases it was first discovered within the same limits.

Aphasia persisted till final unconsciousness in all the fatal cases, and till the patient's discharge from the hospital, a period varying from eleven days to five months, in 9 of the 24 cases which terminated in recovery. In the remaining 15 cases, nearly two-thirds of those in which the patient survived, all aphasic symptoms, except at times some slight hesitation in speech, disappeared in from twelve days to three months. In five of those in which a notable degree of aphasia persisted at the time of last observation, improvement was still progressive and gave promise of complete restoration of motor and sensory function. The statistical prognosis therefore in traumatic cases may be considered good—much better than when the speech defects result from embolism or thrombosis.

Four of the 6 fatal cases afforded opportunity for postmortem examination. The histories of 3 of these were detailed in the Monographs upon frontal localization, as was that of a case in which several forms of aphasia resulted from the growth of a tumor in the left frontal lobe. The relations of aphasic conditions to lesions in these cases is shown in the abstracts of histories which follow.

CASE LXXXVI.—Primary delirium with paraphasia at end of two hours, both of which continued till final coma at the end of thirty-four hours. This patient could utter single words correctly, or a number of words in succession, each correct in itself but strung together without connection: as, " water—father— who," or " Jesus—now—who." He also connected fragments of words as: " en—is—other," meaning when is mother; or " ter— J," for water—Jesus. The clue was found in the words he constantly used.

Lesions.—Fracture and epidural hemorrhage confined to left occipital region and corresponding fossa; thrombus in left lateral and superior petrosal sinuses; moderate subarachnoid serous effusion; laceration involving the exact width and whole thickness of

cortex of first and second left temporal convolutions, 1½ inches long, embracing the second and part of the third fifths of the first, and the middle portion of the second convolution, estimated from the anterior extremity; small and deep laceration in the centre of inferior surface of same lobe; small and shallow laceration at tip of the lobe, implicating all three convolutions; similar laceration at tip of right temporal lobe involving second and third convolutions; extensive laceration of inferior surface of left frontal lobe, extending from its anterior border to the optic chiasm and from the median line outward through first, second, and third orbital convolutions, and into the subcortex; cortical hemorrhage in middle portion of anterior fossæ, extending over sella turcica into middle fossæ; general cerebral contusion indicated by hyperæmia and thrombi in the minute vessels.

CASE LXXXVII.—Paraphasia on the second day, followed on the third by aphemia which was permanent; later right hemiplegia, left facial paralysis, and paroxysms of facial spasm which became general; no sensory speech defects. Death on the sixth day.

Lesions.—Fracture through right middle fossa; general meningeal and cerebral hyperæmia, excessive on the left side; thrombosis of minute cerebral vessels throughout cortex on the left side; subarachnoid hæmatoma derived from rupture of left Sylvian artery, and extending along Sylvian to median fissure, 7 cm. wide in its broadest part; subjacent cortex eroded; neuroglia generally increased.

CASE LXXXVIII.—Primary unconsciousness which continued till second day; muscles spastic; pupils unsymmetrical; lack of rectal and vesical control; single convulsion; aphemia discovered on the third day; visual aphasia and agraphia still later. Death on the eighth day.

Lesions.—Fracture of right parietal bone from anterior inferior angle to parietal eminence; epidural hemorrhage along line of fracture, with flattening and compression of the underlying convolutions; small hemorrhages into pia mater and subjacent cortex of the right frontal lobe, largest upon its inferior surface; extensive laceration of anterior two-thirds of left temporal, and of inferior surface of left frontal lobe; softening and infiltration with blood of inferior portion of first, second, and third left frontal convolutions; entire destruction of left island of Reil; areas of

softening extending from Sylvian fissure to posterior commissure; cortical hemorrhage covering whole frontal lobe; general cerebral hyperæmia; hemorrhages of considerable size in all parts of the pons.

CASE LXXXIX.—Primary unconsciousness and later mental derangements prevented examination as to speech defects until late in the third week; patient then paraphasic, and from that time was irrational or actively delirious and further examination was again precluded. There was no motor aphasia.

Lesions.—Pachymeningitis interna and externa; turbid serous effusion in basal fossæ; general cerebral sclerosis; atrophy of both frontal lobes, more marked in the left; abscess involving left temporal, and anterior part of left occipital lobe.

CASE XC.—*Tumor.*—Motor, auditory, and visual aphasia; amusia and agraphia; all well marked and permanent. Death in the fourth month.

Lesions.—Tumor occupying anterior two-thirds of left frontal lobe; anterior border of Broca's convolution compressed, atrophied and forced backward, with substitution of tumor tissue for degenerated neural elements; inferior border of second convolution slightly involved. The cyst interrupted or displaced the efferent fibres of Broca's convolution; and destroyed all association fibres which entered or left the third, and many of those of the first and second convolutions. The general tissue of the brain presented a normal appearance except in those parts invaded or compressed by the neoplasm.

A point of interest in this case was a complete loss of a language acquired and constantly used in later years, and a reversion to one of childhood long since forgotten. He wrote and spoke in English as well as in French and German before his illness. After his coming to the hospital he spoke only in the Russian tongue which he had not spoken before in fourteen years, and was much annoyed that his attempts to speak in English or German failed. In still another case previously cited the patient had usually spoken in Norwegian, but when he regained the power of speech it was only English. He a little later recalled a few Norwegian words, but their number was not increased. His English vocabulary was gradually extended. Both patients could understand the language which they could not speak.

These observations made in cases with necropsy are supplemented by eight others in which the cranium was opened in operative procedure. Five were cases of compound fracture and three of explorative operation; all in the left fronto-parietal region. Cerebral laceration in the speech area existed in all the cases of compound fracture, but was discovered in none of those subjected to explorations. In one of the exploratory cases a minute pial clot with normal cerebral surface was disclosed; in a second, in which a large area was exposed, the dura mater was tense but on incision no lesion was apparent; and in the third there was temporary lack of cerebral pulsation, but again there was no evident gross lesion. In all the operative cases save one the patient survived.

There were cerebral lacerations corresponding to pre-existing aphasic conditions in all the cases with necropsy, and in three of those with operation for the relief of compound fracture. There were further lacerations in 5 of the 8 cases to which there had been no corresponding form of aphasia; but in each instance the discrepancy was more or less explicable by the persistence of unconsciousness, delirium, or other mental defect. In the two remaining compound fractures the site of injury was distant from the recognized centres of the speech defects observed; and as already stated no gross lesion was discovered in either of the cases in which aphasia was a symptom and exploratory operation was made.

There is no reason so far as these cases are concerned to question the accuracy of the generally accepted localization of centres of control for speech and allied forms of expression; but in several of the cases cited there is conclusive evidence that no gross lesion is essential to their loss. The case of tumor in the frontal lobe in which every sensory aphasic condition was strongly pronounced and in which lesions were strictly confined to the frontal lobe is a marked instance. It has been assumed that in the known or probable absence of cerebral laceration aphasia may result from the compression exerted by a hemorrhage. This assumption is neither substantiated by facts nor sustained by theoretical considerations.

There are in the present series of cases many in which, with consciousness retained and speech conditions normal, a considerable hemorrhage was found to extend over the speech area and there was no case in which, from cumulative hemorrhage in the same region consciousness was gradually lost before death or relief by operation, in which aphasic symptoms were observed at any time in its progress. There have been cases reported in which motor and perhaps other forms of aphasia have been attributed to small localized hemorrhages, but none in which lesion of the brain tissue has been excluded. In a case previously quoted,[22] a limited superficial hemorrhage was regarded as the cause of a motor aphasia; and though some improvement resulted, the continuance of the aphasic conditions for years afterward indicated a deeper seated lesion unrelieved by operation. The effect of a limited cortical hemorrhage would necessarily be lost in that of the underlying laceration and inevitable adjacent limited contusion.

Compression to be effective must be exerted with firmness and precision. The compressing force in epidural hemorrhage is so diffused and minimized by the fibrous shield of dura mater that even when excessive it is deficient in both essential conditions. It may be said in general that no form of intracranial hemorrhage can reasonably be expected to so compress a very limited cerebral area as to destroy its functional activity; when large the compressing force is too diffuse, and when small too slight to be efficient. Aside from this consideration the loss of consciousness which must always attend any large intracranial hemorrhage whether epidural or subdural, will of itself abrogate speech and all other manifestations of intellectual life.

It seems to be well established, therefore, that in aphasia, as with many other focal symptoms, there are many cases in which the essential lesion must be sought in some structural change invisible upon ordinary inspection, or at the most indicated only by some circulatory disturbance. The recovery of the patient in so large a proportion of cases, and the frequent

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[22] *Lib. cit.*

strict limitation of the defect to a single one of its phases as well as its often transitory nature must serve to strengthen the conclusion that it is independent of the grosser forms of injury.

The comparatively short duration of aphasic conditions in some instances is illustrated in the two cases which follow. In two others, one of motor aphasia, and the other perhaps involving some sensory defect, it did not extend beyond the fourth day.

CASE XCI.—A man 38 years of age was admitted to the hospital in an intoxicated condition, with no history and with profuse hemorrhage from the left ear. On the second day he was mentally confused and suffered much from vertigo and general headache. He was unable to state the place of his employment, and could only suggest his occupation of waiter by indicating in dumb show the use of a corkscrew. There were no pupillary symptoms at any time, no loss of rectal or vesical control, and no muscular disorders. On the seventh day his condition was in all respects normal. His temperature ranged 99.2°, 100°, 98°.

CASE XCII.—A man who had been struck upon the head with a bottle was primarily unconscious; but on arrival of the ambulance had recovered consciousness. He could not give his name in speech but could write it. Motor aphasia with no sensory defect continued for eight days without general symptoms. He had sustained a fracture in the left temporoparietal region for which he was trephined and the osseous fragments were elevated and some small pieces removed. There was no evident intracranial lesion beyond a slight epidural hemorrhage.

There was no instance of the exceptional occurrence of left hemiplegia, but there was an instance of paralysis of the left face and left upper extremity which belongs to the same category and is susceptible of the same explanation without the necessity of supposing a cerebral anomaly—for the patient was not left-handed. There were probably bilateral lesions in this case, as has been often noted in other cases in which post-mortem examination was made.

CASE XCIII.—The patient, a man 46 years of age, was knocked down in the street and was at once admitted to the hos-

pital with paralysis of the left face and left upper extremity, slightly dilated and immovable pupils, and normal reflexes. He was semi-conscious; his temperature was 95°, pulse 60, and respiration 24; and he had no extracranial hemorrhages. On the second day he was incoherent and at times wildly delirious. On the third and fourth days his mental condition improved and motion in the upper extremity was restored. On the sixth day he became rational, could repeat single words when dictated, but could not recall his name. On the day following he could remember one of his names, but could not write it, and could not recall with certainty the names of familiar objects, and could not always repeat words or the names of things on dictation. Facial paralysis disappeared, but ptosis and diplopia persisted. On the tenth day he could repeat his full name and he could answer most questions with some hesitation.

The analysis of so large a number of cases, observed under similar conditions, could hardly fail to disclose some new facts in pathology and symptomatology, and to accentuate some others which were perhaps already known. The independence of the symptoms of cranial fracture and of intracranial lesions, the intervention of the sympathetic system in the production of symptoms of intracranial injury, and the relations of temperature to consciousness and in general to prognosis and diagnosis, are some of the more important of its disclosures; but the one fact of paramount importance which it establishes is that the essential lesion is the same in every class of intracranial injuries, and that it is a structural change in the cellular elements; that lacerations and hemorrhages are accidental, and not essential; that whatever influence these lesions may have in determining the more intimate pathological condition they are but a part of a general contusion which may equally occur in their absence. This is the inevitable conclusion which has resulted from the examination of every symptom in detail, focal as well as general, since in each instance many cases were found with no other gross lesion than a more or less well pronounced circulatory derangement or even with no evident change at all.

INJURIES OF THE KIDNEY.*

BY ALEXANDER B. JOHNSON, M.D.,

OF NEW YORK,

Surgeon to the New York Hospital.

On account of the position of the kidney in the abdomen, protected as it is by the spinal column, by thick layers of muscles, and by the thoracic wall, great force is necessary to injure it from behind; and its deep position protects it also from all but extreme degrees of violence from in front. Accordingly, injuries of the kidney are comparatively rare. In battle, injuries of the kidney, as the result of gunshot wounds, are probably fairly common, but in most of the cases associated grave injuries of the spine and of the abdominal viscera so commonly co-exist that the wounds rarely come under the care of the military surgeon. In civil life, also, gunshot and stab wounds of the kidney are relatively rare injuries. Contusions and ruptures of the kidney, as the result of blunt violence without external wound, are much more common; only very rarely are injuries of the kidney by blunt violence associated with an extensive contused and lacerated wound. As might be expected, all the forms of kidney injury are far more frequent in males than in females, and they are more frequent during the second and third decades of life than earlier or later; although in large cities, like New York, where run-over accidents are so common, a considerable proportion of the ruptures of the kidney occur in children. A large proportion of all subcutaneous injuries of the kidney are associated with grave traumatisms to the other abdominal viscera, to the spine, etc. Küster collected the statistics of 306 cases of injury to the kidney without external wound. He found that the right kidney was injured more often than the left, and that 93.98 per cent. of the cases were males, 6.02 per cent. females. A

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* Read before the New York Surgical Society, May 12, 1909.

nearly similar proportion existed among children under fifteen
years of age.   Of these, there were 41 cases, and 33, or 80.48
per cent., were boys; only 8 were girls. .Küster explained the
infrequency of kidney injuries in the female not only by their
less active mode of life and less frequent exposure to external
violence, but also on account of the fact that the broader
pelvis and more prominent crests of the ilia in women served
to protect the kidney from direct ,violence.   Further, that
.women usually have a thicker layer of fat; that their corsets
also probably serve to protect them to some extent.   The
rarity of injuries of the kidney may be illustrated by the fol-
lowing facts: From January 1, 1890, to October 1, 1898, only
7 cases of injury to the kidney, requiring operation, entered
the Roosevelt Hospital in the city of New York, a hospital
where the accident service is very large.   A number of cases
of injury of the kidney other than these were treated in the
hospital by conservative measures, the kidney lesion not being
severe enough to merit operation.   Of the cases operated upon,
all were males, and all but 2 were young adults; the ages
ranged between twenty-eight and ten years.   In 5 of the cases
the injury of the kidney was caused by the patient falling some
distance and striking against some hard object, which injured
the loin or the lateral wall of the belly.   One case was crushed
between two cable cars.   In the seventh case the patient, who
was riding a bicycle, collided with the shaft of a wagon, which
penetrated his right pleura, diaphragm, peritoneum, liver, and
caused a contused and lacerated wound of the right kidney
(Dr. Robert Abbe's case).   Thus 6 of these cases were sub-
cutaneous injuries.   Since 1898 only 6 cases of injury of the
kidney requiring operation have come under my personal ob-
servation.   One was a rupture of the liver, the kidney, and the
lung.   The patient, a child of nine years, survived.   One was
a rupture of both kidneys, ending fatally.   One was a lacer-
ated wound of the kidney, produced by a fractured twelfth rib;
the broken end of the rib penetrated the substance of the kid-
ney.   A fourth was a gunshot wound of the kidney, associated
with wounds of the intestine, diaphragm, and lung.   The

patient died. One was a stab wound of the kidney, requiring suture. One was a subcutaneous laceration of the kidney, requiring nephrectomy on account of persistent bleeding. I recall an unusual case seen by me when I was house surgeon in Bellevue Hospital in the service of Dr. Frank Hartley, a stab wound in the right loin, which opened the peritoneal cavity, wounded the liver, and made a deep cut into the substance of the right kidney. The knife entered between the ninth and tenth ribs, midway between the mammary and axillary lines, and transversed the right kidney from the outer to the inner border. A small urinary fistula persisted for six months.

In 1896 Keen tabulated 155 cases of injury of the kidney. Of these, 19 were gunshot wounds, 8 were penetrating wounds of other descriptions, 118 were subcutaneous ruptures, 6 traumatic hydronephrosis, 2 partial nephrectomy for rupture, 2 ruptured ureter (pelvis). From these statistics one sees that subcutaneous ruptures of the kidney are far more common than open wounds. The injuries to the kidney substance vary much in severity, from slight contusions, attended by only a small amount of hæmaturia, to severe crushing injuries, in which the kidney may be pulpified or torn completely in two. The causes of rupture of the kidney are falls from a height in which the individual strikes some more or less prominent hard object, thus injuring the kidney by direct violence; or sudden and very forcible flexion of the trunk upon itself as the body strikes the ground. Other causes are blows upon the loin or the front of the abdomen, and sometimes violent muscular effort. The cases which I have seen of rupture of the kidney have been chiefly from falls or run-over accidents. Several cases of rupture of kidney from muscular violence have been observed. Thus, Clement Lucas reported the case of an elderly man who was walking behind a wagon loaded with heavy sacks; one of these fell to the ground, and he endeavored to catch it by grasping it suddenly with both hands. He felt a severe pain in the left side of the abdomen and back, and passed blood with his urine. A second case was reported by Campbell. A young girl of fourteen bent her body forcibly

to the left side while jumping over a hedge. She immediately experienced severe pain in the region of the kidney, and passed blood with her urine.

While the mechanism of ruptures of the kidneys by direct violence, the result of crushing injuries or blows upon the front of the abdomen or the loin, is sufficiently clear, other cases of ruptures of the kidney occur in which the violence is exerted against some distant part of the body, as when the patient falls from a height, and suddenly flexes the trunk violently, either anteriorly or to one side. Ruptures of the kidney under these conditions have been explained by the theory of hydraulic pressure, sometimes by the pressure of the ribs. Unquestionably when the lower ribs are broken the kidney may be wounded, as in the case of my own cited above. It is comprehensible that as the result of a sudden violent commotion of the body the kidney might be projected by its own inertia against the transverse processes of the vertebræ, and thus injured. The explanation of ruptures of the kidney by hydraulic pressure was made satisfactorily by Küster, who tried a number of experiments upon kidneys removed from the body and produced ruptures of various kinds, indicating that a sudden increase of hydraulic pressure was the cause of the rupture. He also found that even in the bodies of old persons after the intestine had been removed sudden violent pressure upon the lower ribs of the left side caused the ribs to bend inward and to come into contact with the kidney. In ruptures of the kidney from hydraulic pressure the lines of rupture usually radiate from the hilum toward the twelfth rib. In cases of rupture of the kidney from muscular violence, it is assumed that the muscles acting upon the lower ribs cause them to move inward, and thus compress the kidney against the spinal column.

The character of the injury to the kidney varies, as stated, in a number of ways: In the cases which I have personally seen, in two a simple transverse fissure of the kidney existed, running from the hilum to the convex border. In one the kidney was completely torn in two at about its middle. In one a contusion

of the kidney existed without rupture of the capsule, but with the laceration of an artery in the kidney substance of considerable size, so that an arterial hæmatoma or traumatic aneurism was produced, which bled the patient nearly to death in the course of about four weeks. In another case, operated upon in the Roosevelt Hospital by, Dr. Frank Hartley, there was rupture of the kidney capsule, the kidney itself was extensively contused, and a very large hemorrhage had occurred into its interior, so that the organ was greatly increased in size. Much of the disorganization of the kidney substance had probably been caused by the pressure of extravasated blood. In another case, a child of ten years had a severe injury from a fall upon the right loin and suffered from marked hæmaturia. Exposure of the kidney for septic symptoms two weeks after the injury discovered a necrotic area in the substance of the kidney, rounded in shape, an inch in diameter, and about half an inch deep. In another case, where a man was crushed between two cable cars and developed some weeks later septic symptoms, a large tumor formed in the right loin; the kidney was found completely disintegrated at the time of the operation.

SUBCUTANEOUS INJURIES OF THE KIDNEY.

The various grades of subcutaneous injury to the kidney were classified by Schede into five groups:

1. *Injury of the Fatty Capsule of the Kidney and of the Fibrous Capsule without Injury of the Kidney Substance.*—In these cases there is usually a moderate effusion of blood between the kidney and its fatty capsule; the latter is more or less extensively infiltrated with blood, and may subsequently become thickened and indurated from the formation of new connective tissue. Occasionally the hæmatoma results in the formation of a cyst.

2. *Contusion of the Kidney with Hemorrhage.*—Contusion of the kidney substance with hemorrhage occurs, sometimes without gross lesion, sometimes with the formation of solitary or multiple fissures in the kidney, which may be trans-

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verse or radiating, and are seldom parallel to the long axis of the organ. The ruptures do not extend into the renal pelvis. Such injuries of the kidney, although they may be accompanied by marked symptoms and hæmaturia, which may be profuse, rarely result fatally unless they become infected, or unless a considerable blood-vessel is torn with the formation of a traumatic aneurism.

3. *Fissures, Single or Multiple, in the Kidney Substance, for the Most Part Radiating from the Hilum, but Extending into the Renal Pelvis.*—In some of these, as in one of my own cases, the kidney may be completely torn in two. These cases are attended by profuse hemorrhage into the surrounding structures, into the fatty capsule, into the retroperitoneal tissues, or if the peritoneum in front of the kidney is also ruptured, into the abdominal cavity. The tendency of such hemorrhages is to spread downward into the mesentery of the small intestine, along the course of the spermatic vessels to the groin, into the scrotum, into the labia majora of the female, into the pelvis, and to appear superficially in the skin of the abdominal wall. These cases are very serious. The accompanying extravasation of the urine forms a dangerous complication; a considerable tumor is usually present in the loin after a few days. Hæmaturia may be absent, since the ureter is often plugged by a clot of blood. As a rule, unless operated upon, septic symptoms develop as the result of infection of the mixture of blood and urine, with the production of a large abscess or of a widespread necrotic inflammation of the retroperitoneal tissues. Late secondary hemorrhages may occur as the result of the necrotic process, and such may be fatal.

4. *Complete Pulpification of the Kidney.*—In these cases the kidney is extensively lacerated and torn, and considerable pieces of kidney tissue may be completely separated from the rest of the organ. The result is not dissimilar to class 3. Unless operated upon these patients die of hemorrhage or of septicæmia.

5. *Injuries of the Kidney, accompanied by Rupture of the*

Renal Vessels, Rupture of the Ureter, or Tearing Away the Vessels and the Renal Pelvis from the Kidney Itself.—In these cases, unless operated upon at once, death ensues from hemorrhage or from necrotic and putrid inflammation and septicæmia.

A sixth class might be added in which, in addition to the injury of the kidney, extensive multiple injuries of the other abdominal viscera or of the lung occur, and while always grave injuries, some of them are saved by prompt operation.

Symptoms, Course, and Diagnosis of Subcutaneous Injuries of the Kidney.—Since most cases of rupture of the kidney occur as the result of extreme degrees of external violence, the symptoms of more or less pronounced shock are usually present immediately after the injury, and are due, as in other cases of severe injury to the belly, to the violent mechanical disturbance of the sympathetic and abdominal plexuses of nerves rather than to any injury of the kidney itself. In other cases the symptoms of shock, even after very severe injuries of the kidney, may be entirely absent; the individual may continue to walk about, or even to work for several hours, until he begins to feel faint from internal bleeding, or until his attention is attracted to the presence of blood in his urine. Accompanying the shock, when present, nausea and vomiting are commonly observed, together with the other symptoms of shock.

Pain.—Following injuries of the kidney, severe pain is usually present at the time of the accident, although it may at first be slight, and gradually increase in intensity, as the effused blood causes tension and undue pressure upon the nerves of the kidney and its capsule, and upon the sensory nerves after their exit from the spinal column. The pain is referred to the region of the kidney, and often radiates downward along the course of the ureter into the bladder, the external genitals, and the inner surface of the thigh. External signs of injury in the neighborhood of the kidney may be present or absent; such may be abrasions, ecchymoses, the signs of a fractured rib, etc. Extreme tenderness over the injured kidney is pres-

ent in all cases. If blood is poured out in considerable quantity in the vicinity of the kidney, a tumor mass will be formed behind the peritoneum, which may gradually increase in size for hours or days, and may extend well down to the umbilicus to one side of the median line, and be felt as a distinct tumor mass or as a mere sense of diffused resistance on palpation. Such effused blood may appear after a day or more upon the skin of the lower abdomen, in the region of the inguinal canal, in the scrotum, in the fold of the groin. Usually, if the effusion of blood is considerable, the patient will lie with the thigh of that side flexed to relieve the tension of the muscles of the back and of the abdominal wall.

Hæmaturia.—The most characteristic sign of injury to the kidney is the presence of blood in the urine. It is to be borne in mind, however, that in several groups of cases hæmaturia may be slight or absent. If the injury of the kidney involves merely the fatty capsule and the fibrous capsule without crushing or tearing the kidney substance, no blood will appear in the urine. In very severe injuries of the kidney—namely, those in which the ureter is torn across, or in which the ureter is soon plugged by a blood clot—the quantity of blood in the urine may be small, microscopic, or even absent. In the cases where the ureter is plugged by a clot the appearance of blood may be delayed for many hours or may be intermittent. In these cases attacks of renal colic may occur, followed by the evacuation of blood casts of the ureter. If the bleeding proceeds rapidly down the ureter into the bladder, the appearances will vary in different cases. The patient may urinate blood in large quantities mixed with urine. If the bladder was empty at the time of the accident, the organ may fill up with partly coagulated blood. In these cases the patient will suffer intense pain in the region of the bladder, will have a constant desire to urinate. The contractions of the bladder wall may, however, be insufficient to force the clotted blood through the urethra, so that complete retention may occur with the formation of a tumor above the pubes by the distended bladder. In other cases the patient may be able to empty the bladder partly,

and will pass urine mixed with blood. From time to time the orifice of the urethra will be plugged by a clot and the stream of urine interrupted, causing severe pain. In these cases it may be necessary to empty the bladder with an evacuator, or to suck it out with a large hand syringe and a large metal catheter having one or more unusually wide eyes. In many cases the quantity of blood entering the bladder will be small; the urine will simply be colored slightly or deeply, and will appear not bright red, but smoky or a dull brown color, indicating that the blood has been in contact with the urine for some time. It is, of course, important to distinguish whether the blood comes from the bladder or from the kidney. This is sometimes possible. Usually in hemorrhage from the kidney the urine is evenly mixed with blood; in hemorrhage from the bladder, on the other hand, the last portion of urine passed often contains more blood than the first. The diagnosis may also be made by washing out the bladder. The bladder once evacuated and washed clean, if the hemorrhage comes from the kidney, further washings will be clear or but slightly stained with blood. If the hemorrhage comes from the bladder, repeated washings will usually appear blood-stained, since the mechanical distention of the bladder by the fluid introduced will usually be sufficient to keep up or to inaugurate fresh bleeding. The cystoscope will enable one to clear up the diagnosis in doubtful cases. If the hemorrhage comes from the bladder, the fluid medium will usually become opaque almost at once; if from the kidney, gushes of bloody urine, in case the bleeding is still going on, may be seen proceeding from the orifice of one or other of the ureters; or a clot may be seen adhering to the orifice of one ureter. If the bleeding has permanently or temporarily ceased, the cystoscopic field may be so clear as to enable us to eliminate the bladder as the source of blood. The passage of cylindrical blood casts of the ureter *per urethram*, while characteristic of renal hemorrhage, is inconstant. When the quantity of the blood in the urine is very large, it is seldom possible to make a differential diagnosis as to its source from microscopic examination. Injuries of the kidney

are usually followed by a traumatic nephritis, and after a hemorrhage from the kidney has ceased, examination of the urine will often detect hyaline casts, sometimes containing granules, sometimes red blood cells and renal epithelium. Such a traumatic nephritis is associated with an albuminuria, and the quantity of albumin is greater than can be accounted for by the small quantity of blood present. Polyuria is frequently present in these cases. Traumatic nephritis is sometimes associated with œdema of the extremities, and even with generalized œdema. This is, however, a relatively rare occurrence. In the very extensive ruptures of the kidney the symptoms of internal hemorrhage may be present of any possible grade. In the worst cases the symptoms of progressive anæmia may increase from hour to hour, and unless operated upon the patient may bleed to death in a very short time. In such cases the local signs of the formation of a tumor mass in the region of the kidney will be marked. If the peritoneum has been ruptured, in addition to the signs and symptoms of hemorrhage, there will be evidences of an accumulation of blood in the peritoneal cavity. The hemorrhage following contusion of the kidney may be intermittent, notably if a considerable artery is torn without rupture of the kidney capsule. This is well illustrated by the following case observed in the Roosevelt Hospital in 1894:

The patient was a boy, aged sixteen years. A week before coming to the hospital he had fallen, while running, against a wooden beam, which had injured his right loin. He did not suffer from shock, and walked a considerable distance to his home, where he went to bed, and remained during the following week. He had observed that his urine was red after the accident. Upon admission to the hospital his temperature was 99° F., his pulse 100. He was passing a diminished quantity of urine, 14 ounces in twenty-four hours. This was slightly brownish in color, and contained a moderate amount of blood. There was pain in the region of the right kidney, moderate tenderness, and muscular rigidity. He left the hospital at the end of the three days feeling better, and desiring no further treatment. Twelve days later

he returned. On the preceding day he had passed a large amount of blood *per urethram*. There was no tumor in the loin nor noticeable tenderness. At this time his pulse had become rapid, 110. He had a slight amount of fever. His urine contained some blood. Upon the two following days he passed a considerable quantity of blood with the urine. The bleeding continued during the next five days with the symptoms of progressive anæmia. Three weeks after the accident his right kidney was removed. The kidney was slightly enlarged. There was a bulging tumor at the centre of its convex border. Upon incising the kidney a considerable cavity was found in the kidney substance, an inch and a half in diameter. This cavity contained a globular clot of bright blood, inclosing firm clots and masses of fibrin, partly decolorized. In the wall of the cavity the open mouth of an artery of considerable size plugged with a soft and recent thrombus was discovered. The capsule of the kidney was not ruptured.

The course of a case in which the kidney was torn completely in two will serve to illustrate another type.

The patient was a man, aged twenty-two years, who was admitted to the Roosevelt Hospital, February 7, 1898. On the day of admission he had fallen, while walking along a beam, a distance of six feet, and had struck with his left loin on the end of a post. He suffered sudden, sharp pain in the loin, and exhibited symptoms of shock. Upon admission to the hospital, examination showed a large, robust man. He was very pale. His pulse was soft and slow, 72 beats per minute. Temperature normal. There was marked tenderness in the left loin over the kidney and abdominal rigidity in front. There was dulness on percussion in the left loin, extending forward as far as the vertical plane, passing through the anterior superior spine of the ilium. Half a pint of nearly pure blood was removed from the bladder by a catheter. The urine for the next two days was continuously bloody. The third day after the accident the blood had nearly disappeared from the urine. The patient was profoundly anæmic. He developed a septic temperature, 104.5° F., his pulse was 115. There was pain, rigidity, and marked bulging of the abdominal wall in the left hypochondriac region and pos-

teriorly. On this day I removed his kidney through a cut parallel with the border of the ribs. Upon approaching the kidney a large retroperitoneal hæmatoma was opened, containing nearly a quart of fluid blood. At the bottom of this cavity the kidney was found torn transversely completely across into two equal portions. The torn edges and the adjoining kidney substance were extensively pulpified. The kidney was removed. Blood entirely disappeared from the urine after the operation, and thirty-four ounces of urine were passed during the first twenty-four hours. The patient made an uninterrupted recovery.

The following case history illustrates that a serious subcutaneous rupture of the kidney may be attended by trifling symptoms at first. In this case the kidney and the pelvis of the ureter were torn by a fall against a hard object.

The persistent hemorrhage would, no doubt, have caused the patient's death had not the kidney been removed.

A. C., male, aged fifty-nine years, native of France, a cook.

On July 6, 1907, at about 7 A.M., he was lowering a small cart down some stone steps. He stumbled and fell a distance of only two or three steps, striking on his left side against the edge of the lowest step. He experienced a sharp pain in his side, but arose, went about his work, and did not consider himself seriously hurt. He had some pain, like a stitch, in his left side, some difficulty in taking a deep breath, and that was all. Nearly eight hours later he had a strong desire to urinate; he went to the closet; urination was difficult and painful, and he observed that his urine was deeply stained with blood.

He sent for and was brought to the New York Hospital in an ambulance.

On Admission.—Patient is a large, stout, and fat man. Skin and mucous membranes normal in appearance. There is a fracture of the tenth rib on the left side about three inches from its anterior extremity.

Abdomen.—There is tenderness beneath the free border of the ribs in the left hypochondrium, and tenderness in the lumbar region of the same side. Temperature, 98.2° F.; pulse, 76; respirations, 20. The patient urinated liquor of a dark wine-color. The patient entered the service of Dr. F. W. Murray. He was

kept quiet in bed. His urine continued bloody. On the eleventh day of July, four days after admission, his hæmoglobin was 60 per cent.; on the seventh day after admission it was 58 per cent.; on the ninth day after admission it was 52 per cent. On that day the left kidney was exposed by Dr. Murray through a five-inch incision parallel with the twelfth rib. The fatty capsule of the kidney was found infiltrated with blood. The kidney itself appeared swollen in its lower half. The capsule propria was incised and the incision gave exit to blood clots. The hæmatoma was cleaned out and the wound in the capsule drained by a strand of gauze. Suture of the external wound. The patient then fell under my care. From July 16th until July 19th the patient continued to pass bloody urine. He suffered from painful and difficult urination and much vesical tenesmus. On this day I again exposed the kidney through the same incision. A jagged rent was found in the posterior surface of the kidney near its lower pole. The tear extended from a point an inch and a half distant from the hilum inward and opened the pelvis of the ureter for a distance of an inch. The borders of the rent in the kidney substance were friable and appeared to be necrotic. The kidney was removed. The patient made a good and satisfactory convalescence. In addition to the lesions described, the kidney contained several small areas of contused tissue resembling infarcts. These areas were necrotic.

Operative Indications.—Only the more severe subcutaneous injuries of the kidney demand immediate operation, the indications being the rapid development of the general symptoms of hemorrhage—namely, acute progressive anæmia or the formation of a tumor mass surrounding the kidney combined with such symptoms or alarming hemorrhage through the ureters and bladder. A good many of the cases where the kidney substance is contused but the capsule is not ruptured, and where the contusion does not extend into the renal pelvis, are attended by only a moderate amount of hæmaturia, which gradually subsides, and is followed by a return to health. In the cases where a considerable artery is torn, with the formation of an arterial hæmatoma in the kidney, repeated hemorrhages of a severe grade constitute a positive indication for

operation. In those cases where the capsule of the organ is torn and where blood and urine are extravasated into the surrounding tissues in the absence of indications for immediate operation on account of hemorrhage there will develop in the course of days or weeks septic symptoms which are accompanied by characteristic signs: The formation of a boggy, tender tumor in the loin, profound prostration, etc., and in these the operative indications will become quite plain. In the cases attended by severe degrees of shock, or accompanied by injury of other important organs, the operative indications must be diagnosticated upon general principles. The surgeon will seek to differentiate the symptoms of shock and hemorrhage. If the symptoms of shock are gradually recovered from in the course of hours, the surgeon may safely wait, unless the amount of bleeding from the kidney is alarming or unless the symptoms of internal hemorrhage are manifest. Those ruptures of the kidney, accompanied by laceration of the peritoneum and extravasation of blood into the peritoneal cavity, will be attended by the symptoms of peritoneal irritation, and, if not operated upon, by peritonitis. The general signs and symptoms of severe abdominal injury, the history of the accident, the presence of severe abdominal pain, rigidity of the abdominal wall, will furnish indications for immediate operation, as in other injuries of the abdomen.

INCISED AND STAB WOUNDS OF THE KIDNEY.

Incised and stab wounds of the kidney are rare injuries as compared with subcutaneous lacerations. The recorded cases in modern publications appear to number less than one hundred. In the American Civil War no case of incised or punctured wound was recorded (Otis). The wounds have been produced by cuts and thrusts with knives, daggers, bayonets, rapiers, scythes, scissors, rarely by impalement on sharp stakes; in one case (Murphy) a man fell upon the handle of a hayfork, which entered the rectum, penetrated the colon, and crushed the upper pole of the left kidney. In Abbe's case the pole of a wagon entered the thorax, wounding the

pleura, liver, and kidney. The wounds have varied in size from narrow punctures to incisions wide enough to permit the prolapse of kidney. Wounds made in front have usually been complicated by injury of other abdominal viscera. Wounds made from behind usually involve the pleura, sometimes the liver.

Signs, Symptoms, and Diagnosis of Incised and Stab Wounds of the Kidney.—From the size, situation, and depth of a wound, injury of the kidney may be visible on inspection or palpation. In other cases the injury may be inferred more or less certainly from concomitant signs and symptoms, or from the character and length of the instrument which produced it, the degree of violence, and the direction of its application.

The free escape of urine from the wound indicates injury of the kidney, involving the pelvis or a wound of the ureter; hæmaturia will usually co-exist. In wounds of the cortical substance merely, both of these signs will usually be absent, or a small amount of transient hæmaturia alone may occur. Urine escaping from the external wound, either alone or mixed with blood, may be recognized by the urinous or ammoniacal odor soon developed in the saturated dressings. If the size, situation, and shape of the wound in the abdominal wall be unfavorable for its escape, the urine will be extravasated into the perirenal tissues or into the peritoneal cavity, and a septic inflammation or a peritonitis will follow, as the case may be, giving rise to characteristic symptoms and signs—*i.e.*, localized pain and tenderness, a boggy swelling in the loin, fever, prostration, etc., or evidences of peritoneal irritation if the extravasation has taken place into the peritoneal sac.

Hæmaturia.—As stated, when the renal pelvis is opened, the appearance of blood in the urine may be almost immediate, and this sign, together with the situation of the wound, is almost certain proof of a wound of the kidney; a wound of the ureter or its pelvis is the sole alternative. Hæmaturia may be absent if the cortex only is wounded, or if the ureter or pelvis is completely divided, or if the ureter is plugged by a

clot, or if a large renal vessel be divided, so that much blood escapes into the peritoneum, into the perirenal tissues, or externally. In some cases blood will accumulate in the bladder, giving rise to vesical tenesmus and frequency, sometimes to retention, as described under Subcutaneous Injuries of the Kidney. Hæmaturia may be delayed for hours, even for days, and may be small in amount, or so severe as to cause death from loss or shock.

The symptoms of shock and the general symptoms of hemorrhage may be present or absent, and possess no distinctive diagnostic importance.

Pain.—Incised wounds of the kidney are not necessarily very painful. The external wound causes pain similar to that of any wound, but the wound of the kidney itself is not accompanied by severe pain unless the tension of the capsule of the organ is increased by blood extravasated beneath it, or unless the pelvis or ureter is plugged by a clot; there will then occur severe pain of a spasmodic character, a typical renal colic, often associated with nausea and vomiting. The pain radiates downward along the ureter into the groin and testis; the latter is retracted. The development of wound infection, of urinary infiltration, or of peritonitis will be accompanied by pain of a character described elsewhere.

To sum up the early diagnostic features of wounds of the kidney I quote from Henry Morris:

(1) That a wound of the renal region followed by the escape of urine through the wound is conclusive of injury of the kidney; (2) that such a wound quickly followed by the discharge *per urethram* of urine heavily mixed with blood is almost conclusive, if not quite so; (3) that such a wound followed by retention of urine, or lumbar or abdominal pain and dysuria, even without hæmaturia, is highly suggestive of a superficial wound and blockage of the ureter; (4) that hæmaturia followed by traumatic peritonitis is strong evidence of an injured kidney.

The following case of stab wound of the kidney was recently treated by me in the New York Hospital:

William C., aged thirty-nine, native of the United States. Foreman of a gang of workmen employed in the construction of a building close by the hospital. At 3 P.M. on September 4, 1906, he got into an altercation with an Italian peddler who was obstructing the sidewalk; as the foreman turned to walk away the peddler stabbed him in the back with a knife having a blade four inches long, sharpened on both edges and three-quarters of an inch wide. The wounded man felt weak and sick; he walked into the hospital, two hundred feet away. He had no pain. Upon admission, examination showed him to be a large, muscular, well-nourished man. He looked pale, his pulse was rather rapid; sole complaint, a feeling of weakness. Upon inspecting the seat of injury, there was a linear wound—three-fourths of an inch long running obliquely downward and forward—situated four inches from the middle line of the back upon the right side, between the eleventh and twelfth ribs. The wound scarcely bled. There were no signs indicating injury of the pleura or lung. After being in the hospital half an hour he urinated three ounces of bright blood.

A diagnosis was made of stab wound of the right kidney. The patient was kept under observation until the following morning, when the continued presence of large quantities of blood in the urine caused me to expose the kidney through an incision below and parallel to the last rib. A portion of this rib was removed to permit easier access to the kidney. There was a hæmatoma of moderate size in the perirenal fat. The kidney was freed and delivered into the external wound. A horizontal linear wound three-quarters of an inch long was then seen on the posterior surface of the organ near the outer border; this wound bled freely as the result of the manipulations. A blunt instrument passed freely through the kidney into the ureteric pelvis. The wound in the kidney was sutured and the bleeding stopped by a single mattress stitch of catgut. The operation wound was then closed in layers, except for the posterior angle, where a gauze wick was introduced down to the kidney. The stab wound in the external soft parts was let alone. After the operation the hæmaturia was at once reduced to a minimum and soon ceased. Primary union was obtained in the sutured portion of the wound and no apparent leakage of urine took place. The

patient had a rapid and normal convalescence and was able to return to his work in a few weeks.

Prolapse of the Kidney through a Wound.—Wounds in the lumbar region below the ribs, if of sufficient size, have been followed in a number of instances by total or partial prolapse of the kidney; the kidney may or may not be injured. The prolapse has occurred at once from increased intra-abdominal tension, produced by coughing or vomiting, or at a later period. Constriction of the pedicle of the kidney by the wound margins, usually sufficient only to occlude the renal vein, causes swelling and congestion of the organ, profuse hemorrhage from an existent wound of the kidney itself, or, in other cases, hæmaturia. If the kidney remains unreduced, thrombosis of its vessels occurs, followed by gangrene. The diagnosis is to be made on inspection if the prolapse is complete; if partial only, digital exploration would at once reveal the characteristic shape of the kidney.

The Prognosis of Incised Wounds of the Kidney.—The prognosis of incised wounds of the kidney varies within wide limits, according to the presence or absence of complicating injuries. Simple incised wounds of kidney cortex heal well if not infected, usually *per primam.* Injury of the renal artery or vein is attended by such severe bleeding that speedy death results unless immediate surgical aid is at hand. Death from sepsis due to urinary infiltration, or from peritonitis, is common in untreated cases; a wound opening the renal pelvis or the peritoneum has probably been present in many of these. In some cases death has been due to nephritis; to uræmia from suppression of urine; in a few cystitis has been recorded as the cause of death.

Among 8 cases tabulated by Keen, 6 recovered and 4 died —1 from uræmia, 1 from sepsis and abscess of the liver. In 12 cases reported by Edler death occurred in 5, and was due to primary bleeding twice, twice to secondary bleeding, in 1 death followed nephrectomy. Among Keen's cases, 4 were treated by nephrectomy; all recovered. Küster collected 43

cases with 10 deaths; among these cases many had severe complications. Of 31 uncomplicated cases, but 4 died. The prognosis is profoundly modified by prompt and efficient treatment and, on the other hand, by neglect.

GUNSHOT WOUNDS OF THE KIDNEY.

Bullet wounds of the kidney uncomplicated by other serious injuries are rare; the renal vessels, the pleura, lung, diaphragm, liver, stomach, spine, etc., are very commonly injured as well; such wounds are so rapidly fatal that, when received in battle, they rarely come under treatment. The explosive effect of the high-powered rifle bullet is well marked on the kidney; the organ is often found torn in all directions or reduced to a pulp; even wounds from pistol bullets show a considerable degree of laceration of kidney tissue. Simple perforations from high-powered rifle bullets are only seen at extreme ranges. Among the cases of pistol-shot wounds, if the bullet merely grooves the cortex, or if the injury is confined to the cortex, the prognosis is much better than though the pelvis and the renal vessels are injured. Small pistol bullets fired at low velocities may perforate the kidney without producing very serious damage, and a number of such cases have, undoubtedly, recovered without operative interference.

In the simpler forms of gunshot wound of the kidney hemorrhage is not usually very profuse. The dangers are shock from complicating injuries; hemorrhage from injuries of the renal vessels, sepsis from wound infection, caused by unclean manipulations of the wound, from extravasation of urine, from the entrance of foreign bodies—i.e., portions of clothing along with the bullet; from an ascending infection caused by imperfect asepsis in catheterization, the production of cystitis and infection of one or both kidneys.

The number of recorded cases of gunshot wounds of the kidney in which no other important structure has been wounded is not very large. In warfare the frequency of gunshot wounds of the kidney was estimated by Edler, and independently by Küster, at 0.12 per cent. of all wounds. Statistics

compiled from a number of sources indicate that penetrating gunshot wounds of the abdomen involve the kidney in about 7.3 per cent. of the cases. The following statistics give some idea of the mortality in gunshot wounds of the kidney.

In the American Civil War 85 such wounds were followed by 26 recoveries and 59 deaths—a mortality of 69.41 per cent. In the Franco-Prussian War, among 15 gunshot wounds of the kidney there were 8 deaths and 7 recoveries—a mortality of 53.33 (Küster). These results represent wounds from large soft-lead bullets in pre-antiseptic days. The prognosis of wounds of the kidney occurring in civil life, such being, for the most part, pistol-shot wounds, is notably better; thus, Küster collected 29 such cases, with 21 recoveries and 8 deaths—a mortality of 28.41 per cent. The prognosis is, as already stated, profoundly modified by associated injuries.

Experiences gained in recent wars seem to show that uncomplicated wounds of the kidney produced by small-calibre rifle bullets at long ranges may be simple perforations, and so long as they do not open the pelvis or injure the renal vessels may heal without operative interference and without trouble. It is to be borne in mind that though no serious bleeding may occur immediately, the separation of the eschar produced by the bullet, at the end of five to ten days, may be followed by serious or even fatal secondary hemorrhage, evidenced by profuse hæmaturia or by the formation of a perirenal hæmatoma, or by bleeding from the external wound. In some cases the colon has been wounded and the blood has escaped *per rectum*. Infection and perirenal suppuration are quite prone to occur; a certain number of instances of this kind have been observed as the result of the passage of a foreign body, usually a piece of cloth, into the wound, and, in a few instances, such fragments of cloth have eventually been passed *per urethram* after months of perirenal suppuration, pyelitis, and cystitis.

Diagnosis of Gunshot Wounds Involving the Kidney.— The diagnosis of gunshot wounds involving the kidney may sometimes be made from the objective signs of injury of the kidney, as already described; in other cases the symptoms will

be those of shock and intra-abdominal bleeding, as in stab and incised wounds. The cardinal signs are *hæmaturia* and the *escape of urine* from the external wound. Owing to the narrow wound of entrance, this latter sign is much less common in gunshot injuries. If the ureter is plugged by a clot, severe renal colic may be present.

In gunshot wounds involving the abdominal viscera, operated upon for the control of bleeding or for the repair of wounds of the hollow viscera, it will be rare that the surgeon can diagnosticate injury of the kidney before opening the obdomen, unless hæmaturia or kidney colic have existed. The anatomical site of the wound and the direction of the wound canal may aid in the diagnosis, notably when made by a small-calibered jacketed rifle bullet, since, as stated elsewhere, these bullets pursue a straight course through the body. The track of a soft-lead pistol bullet through the tissues, on the other hand, can only be surmised, deflection being caused by bones, tendons, and fascial planes in a large proportion of cases. The location of a lodged bullet may be determined by means of stereoscopic radiographs or with one or other form of localizer; such measures might possibly locate a bullet lodged in the kidney, but would scarcely be of much diagnostic aid in ordinary cases.

THE SURGICAL CONCEPTION OF PANCREATITIS.*

BY CHARLES N. SMITH, M.D.,

OF TOLEDO, OHIO,

Gynæcologist to St. Vincent's Hospital.

THE surgery of the pancreas has, until quite recent years, consisted in the rather infrequent incision and drainage of pancreatic cysts and the drainage of effusions into the lesser peritoneal sac, the so-called pseudocysts of the pancreas. At the present time, however, there is rapidly coming a better understanding of pancreatic disease, and, owing to the investigations and writings of Robson, Moynihan, Cammidge, Opie, and others, not only the importance and the prevalence of inflammatory diseases of this essential and dual organ, but also the means of diagnosis of these conditions, are becoming more generally appreciated and are gaining the attention which their importance demands.

The frequent occurrence of cholelithiasis as the essential etiological factor in pancreatitis demands most thoughtful consideration, as must the fact that pancreatitis may eventually become an incurable condition, or, by extension of the inflammatory process to the islands of Langerhans, result in intractable diabetes. A more general recognition of these facts cannot do otherwise than stimulate the profession to earlier and more frequent surgical removal of gall-stones, as a prophylactic measure aimed against a probable pancreatitis and a possible diabetes.

Introductory to a presentation of the surgical conception of pancreatitis, certain rather elementary statements concerning the surgical anatomy and relations of the pancreas will assist in the ready grasp of the main points at issue, which fact must serve as an excuse for presenting them at this time.

The pancreas, a long, narrow, lobulated organ, from five

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to six inches in length, extending from the concavity of the second and third portions of the duodenum to the inner border of the spleen, is situated mainly in the epigastrium, behind the stomach and the lesser peritoneal cavity. Its head is not only intimately connected with the duodenum, enveloping about one-third of the circumference of that organ, but the upper portion of its anterior surface is also attached by areolar tissue to the transverse colon. The narrow, constricted portion of the pancreas, known as the neck, is in contact with the first portion of the duodenum and with the pylorus whenever the stomach is distended.

The anterior surface of the body is covered by peritoneum, forming the posterior wall of the lesser peritoneal sac, lying between it and the stomach, while the posterior surface of the entire organ is devoid of peritoneum, being directly attached by areolar tissue to the posterior abdominal wall and to adjacent organs and structures. The posterior surface of the head is channelled by a groove, or pierced by a canal, in which lies the common bile-duct.

The main secretory duct of the gland, the duct of Wirsung, having its origin from small radicles in the tail, passes transversely toward the right through the body, but as it enters the head it swerves backward and downward until it comes into rather close contact with the common bile-duct, and together these two ducts penetrate the wall of the second portion of the duodenum and open into its lumen about four inches below the pylorus. A second or subsidiary duct, the duct of Santorini, draining only the head of the pancreas and being of functional importance in less than fifty per cent. of individuals, opens as a rule into the duodenum from three-fourths of an inch to an inch above the opening of the duct of Wirsung. Occasionally the secondary duct empties into that of Wirsung a short distance above the junction of the latter with the common bile-duct, or it may open by one extremity into the duodenum and by the other into the duct of Wirsung.

A rare but, from a surgical standpoint, an important anomaly of the pancreas consists in the complete investment of the

duodenum by the head of the pancreas. Enlargement or distortion of the head under such a condition, by either new growth or inflammation, may so encroach upon the duodenum as to produce obstruction of the bowel, attended by the symptoms of pyloric obstruction. A more common, but still rare, anomaly is the occurrence of an isolated mass of pancreatic tissue, generally situated in the muscular layer of the wall of the small intestine and opening into the lumen of the bowel by an individual duct.

The infections of the bile-tract, either with or without the presence of gall-stones, are such important etiological factors in pancreatitis that a study of the relations of the common duct to the pancreas and its excretory duct materially assists in arriving at our conception of the surgical nature of pancreatitis. The first and second, the supraduodenal and the retroduodenal portions of the common bile-duct possess no anatomical relations of importance in connection with pancreatitis, but the relations of the third, or pancreatic portion, and the fourth, or intraparietal portion, lying within the structures of the wall of the duodenum, are of the greatest etiological importance.

According to Helly, the pancreatic portion of the duct, which is in contact with the pancreas for a distance varying from 2 to 7 cm., ran in a canal completely surrounded by pancreatic tissue in 62.5 per cent. of the cases examined by him, while it ran through a groove on the posterior surface of the gland in but 37.5 per cent.. In 58 subjects examined by Bunger, the bile-duct was completely covered by glandular tissue in 55 and ran uncovered in a groove in 3 only. Moynihan dissected the pancreatic portion of the common bile-duct in 20 cases and found the duct completely covered in 13 and lying in a deep groove, overlapped, but not completely covered, by pancreatic tissue in 7 only. The important bearing of these varying relations of the bile-duct to the pancreas becomes at once apparent in the consideration of possible obstruction of the common duct due to the pressure of the swollen head of the gland in pancreatitis and in malignant disease. Swelling of

the head of the gland is certain to seriously impede, if not obstruct, the outflow of the bile in that large proportion of cases in which the lobules of the gland completely surround the bile-duct, while the latter structure is as sure to escape compression by being displaced to one side when more fortunately, although less frequently, situated in a groove uncovered by pancreatic tissue.

In October, 1908, I operated upon a case of chronic pancreatitis, secondary to cholelithiasis, with that profound stationary jaundice so characteristic of pancreatic obstruction, as contrasted with the ebb and flow of the jaundice in obstruction of the common duct by stone, in which a painstaking examination of the bile-ducts proved the absence of stone in the common duct, but showed that the duct was entirely surrounded by pancreatic tissue, the enormous swelling of which had completely obstructed its lumen.

In another case of chronic pancreatitis, secondary to cholelithiasis, operated upon November 4, 1908, for Drs. Reynolds and Rohne of Defiance, in which there was no jaundice, with no stone in the common duct, but with 4 stones in the cystic duct and 53 in the gall-bladder, there was swelling of the head of the pancreas almost as great as in the above-mentioned case, but with absolutely no obstruction of the common duct. Evidently the pancreatic portion of the duct in this case was either in a groove on the surface of the gland or, at least, too superficially situated to be affected by the glandular swelling. Access to the head of the pancreas, in each case, was gained by mobilization of the duodenum as in Kocher's gastroduodenostomy, with inward displacement of the duodenum and lifting forward of the head of the pancreas.

The various modes of termination of the common bile-duct and the pancreatic duct in the duodenum are of great interest in this connection. Four distinct modes of termination are described by Letulle and Nattan-Lorrier, although there is but slight practical difference between the third and fourth. In the first, which is the usual mode of termination, the common bile-duct, lying above, and the pancreatic duct, lying below,

unite to form a common, oval-shaped canal in the wall of the duodenum, the ampulla of Vater. The duodenal opening of the ampulla is the narrowest portion of the bile-tract, having an average diameter, according to Opie, of but 2.5 mm. In the second mode of termination the two ducts unite before reaching the duodenum, forming a common canal or duct opening into the duodenum by a small, flat, elliptical opening, no ampulla being present. In the third type, the two ducts open side by side into a depression or fossa in the wall of the duodenum; while in the fourth, the independent orifices of the ducts open at the summit of an elevation or caruncle. No ampulla is present in this type. In the later consideration of pancreatitis secondary to cholelithiasis, with the presence of a stone in the ampulla, or in the distal extremity of the common duct, the importance of the mode of termination of the bile- and pancreatic-ducts will become apparent.

As has been shown above, the head of the pancreas is in intimate relation with the duodenum and, naturally, it may be seen that either inflammation or malignant disease of the one may involve the other.

The close relation of the stomach, especially the pyloric portion, the favorite site of gastric cancer, with the pancreas, makes possible the secondary involvement of the pancreas in cancer of the former, a condition which, of course, contraindicates a gastrectomy which otherwise might be indicated. This was strikingly illustrated in a case operated upon by me a few weeks ago, in which a partial gastrectomy for cancer of the lesser curvature of the stomach, with no apparent symptoms of pancreatic involvement, seemed to be indicated until operative exploration disclosed, not only adhesion of the stomach to the pancreas, but also the involvement of the latter organ in the malignant process.

Adhesions between the stomach and the pancreas resulting from disease of either organ, as in ulcer of the one or inflammation of the other, not only materially complicate the indicated operative procedure, but also add greatly to the rate of operative mortality. These results are especially evident in

malignant disease of the stomach involving the pancreas. Mikulicz found in 91 partial gastrectomies with no operative injury to the pancreas, a mortality of 27.5 per cent., but a mortality of 70 per cent. in 30 cases in which the pancreas was injured or in which, from operative necessity, a portion of the pancreas was removed. The lesson to be drawn from his experience and deductions is self-evident.

Ulcer of the posterior wall of the pyloric portion of the stomach, especially when approaching a condition threatening perforation, may lead to adhesions between the stomach and pancreas with subsequent secondary infection of the latter. Mayo Robson reports an interesting case, in which ulcer of the stomach, by adhesion and extension of infection to the pancreas, provoked an acute pancreatitis, with the subsequent formation of a pancreatic abscess which eventually ruptured into the stomach and was cured by stomach and pancreatic drainage by means of a gastrojejunostomy.

Operative procedures on the stomach necessitating the separation of adhesions between it and the pancreas, the result of gastric ulcer, must be conducted with the greatest regard for the preservation of the integrity of the pancreas, as the chances of a successful operative issue diminish in inverse ratio to the amount of injury to the pancreas.

The fact that the peritoneum, reflected over the anterior surface of the pancreas, forms the posterior wall of the lesser peritoneal cavity, is of the utmost surgical importance. Much confusion has arisen over the pathology of, and the differential diagnosis between, true pancreatic cysts and effusions of fluid into this lesser peritoneal sac, the so-called pseudocysts of the pancreas. Jordan Lloyd, in 1892, called attention to the differences distinguishing the two conditions, and yet to-day we read case reports of the two conditions, hopelessly confounded, in the same paper and under the same title. The employment of the term " pseudocyst of the pancreas " is unfortunate because misleading and begetting a false idea in pathology. True cysts originate within the glandular tissue of the organ itself and are covered with, and separated from the lesser peritoneal

cavity by, the layer of peritoneum covering the anterior surface of the pancreas. Effusions of fluid into the lesser peritoneal cavity, while they may result from injury or disease of the pancreas, are entirely, originally and ultimately, outside of that organ and separated from it by peritoneum. The differential diagnosis between the two conditions is difficult and at times impossible. Owing to this fact, to mistaken ideas in pathology, and. to faulty deductions from necessarily hasty and incomplete investigations upon the operating table, unquestionably many cases of effusion into the lesser peritoneal sac are reported in the literature of pancreatic disease, classified as true cysts of the pancreas.

A most interesting case of effusion into the lesser peritoneal sac was referred to me for operation by Drs. Sharpe and Grosh. From a slight elevation of the abdominal wall over the stomach, present when first seen, this patient developed in four day's time an enormous fluid distention of the entire upper central abdominal cavity. A history of preceding attacks of biliary colic and the presence of a mild degree of jaundice led to a diagnosis of pancreatitis secondary to cholelithiasis with, owing to the rapid increase in size of the abdominal swelling, an effusion into the lesser sac, probably hemorrhagic in nature. Operation showed the lesser sac to be distended with blood, bile, and pancreatic fluid. Two moderate-sized gall-stones and the disintegrated remains of others were removed from the lesser cavity well over to its left extremity. The common bile duct and presumably the duct of Wirsung were ruptured. There was positively no history of trauma in this case. Under free drainage the patient slowly but steadily recovered.

Histologically considered, the pancreas is a compound tubular gland, the branching ducts terminating in tubular acini. A small collection of secreting glands, held together by fibres of connective tissue, form a primary lobule. The grouping together of a number of primary lobules constitutes a secondary lobule, and a further grouping gives a large tertiary lobule, just discernible by the naked eye. The lobules are supported by connective tissue, both interlobular and intralobular. These are the secreting structures from which flow the digestive or

external secretion of the pancreas, which is collected by the pancreatic duct and by it poured into the duodenum.

Langerhans, in 1869, described certain ovoid groups of cells, either distinctly or irregularly polygonal in shape, irregularly placed in the intralobular structures of the pancreas and having no connection whatsoever with the pancreatic duct or its radicles, nor possessing any form of excretory duct. These are the islands of Langerhans, which elaborate the internal secretion of the gland, which controls the metabolism of the carbohydrates.

Thus the pancreas is a dual gland, with two distinct and separate secreting structures, each elaborating its own peculiar secretion. While the external secretion is the most important and the most effective of the digestive fluids, its function may be carried on, under necessity resulting from pancreatic disease, by other digestive fluids and by the intestinal bacteria; but the internal secretion from the islands of Langerhans has, in the light of our present knowledge, no proven assistant, unless it be the glands of Brunner in the duodenum, and inhibiting or destructive disease of these insular structures at once results in an arrest of carbohydrate metabolism. If the contentions of certain recent investigators prove true, to the effect that lesion of the islands of Langerhans is the result, rather than the cause, of diabetes, then must we rewrite the pancreatic pathology of diabetes. For the purposes of this paper, the pancreatic origin of diabetes is accepted without prejudice to the claims of these recent writers.

Frequent and deliberate detailed study of the pathology of pancreatic disease is beset by many difficulties, chief among them being the fact that post-mortem changes, including an apparent autodigestion, occur with a rapidity so extreme as to preclude satisfactory pathological examination, either macroscopical or microscopical, at autopsy. It is due to the rapidity and the pronounced degree of these changes, indeed, that not only the nature of existing pancreatic disease has been misinterpreted, but also that its actual presence has been so generally overlooked in the routine post-mortem examinations in our

large hospitals and public institutions. Mayo Robson, in referring to the rapidity of these changes, impressively says: "Only those who have seen and handled an inflamed pancreas can realize how an engorgement and swelling of the gland which was perfectly evident at the time of operation may, if the organ is examined a few hours later on the post-mortem table, have entirely disappeared, leaving a structure which is pale and flaccid, presenting, in fact, no marked deviation from the normal." It is from the surgeons, operating especially for gall-stones and the diseased conditions allied therewith, that the greater portion of our knowledge of pancreatic pathology in the human being has been obtained. Necessarily, the investigations of surgeons during the course of operations cannot be conducted with that thoroughness and deliberation attendant upon laboratory examinations, nor can sections of the pancreas be removed for subsequent microscopical examination, owing to the ulterior results arising from wounds of this organ.

In view of all these difficulties, our knowledge of pancreatic pathology is, as yet, considerably confused, and the literature of the subject contains many conflicting statements and theories. The one great fact of general acceptance, however, which stands out pre-eminently in this mass of confusion, is that practically all the important diseased conditions of the pancreas, including malignant disease, fatty degeneration, lesion of the islands of Langerhans resulting in intractable diabetes, true retention cysts, effusions into the lesser peritoneal cavity, profound and fatal intrapancreatic and extrapancreatic hemorrhages, and pancreatic calculi, are, in many instances at least, dependent upon a pre-existing pancreatitis, either acute or chronic, and that this causal pancreatitis is frequently associated with, and etiologically dependent upon, concretions within the biliary tract or the concomitant infection incident thereto or resulting therein.

Another point of decided surgical interest, concerning the occurrence of which there can be no differences for discussion, relates to the frequency, as yet scarcely appreciated, of hemor-

rhage, either mild or severe, into the substance of the pancreas, or immediately beneath the peritoneum on the anterior surface of the organ, resulting in a bulging encroachment upon the lesser peritoneal sac, or of hemorrhagic effusion into the lesser sac itself, these hemorrhages being incident to the course of a pancreatitis. The comparative ease with which the pancreas may be injured and hemorrhage provoked must constantly be borne in mind when operating upon structures adherent or contiguous to the pancreas, and particularly when exploring the distal extremity of the common bile-duct. This possibility of traumatic hemorrhage, as in that of spontaneous or non-traumatic hemorrhage, is considerably increased if pancreatitis, or malignant disease of the pancreas, either with or without jaundice of pancreatic origin, be present, owing to the marked urinary elimination of the lime salts of the blood in the course of a pancreatitis, materially interfering with and delaying the time of blood coagulation.

This tendency to hemorrhage in pancreatic disease is rather frequently shown in the occurrence of hemorrhage in the body structures apart and distant from the pancreas. One of my recent cases had many repeated hemorrhages into the skin, giving the appearance of severe contusions, a point which was of decided diagnostic value, as these petechial hemorrhages are by no means rare in the course of a pancreatitis. Moynihan observed, in one case of cancer of the head of the pancreas, severe and repeated hemorrhages from the bowel, and others have reported extreme and even fatal hemorrhages within the abdomen but apart from the pancreas, during a pancreatitis.

Pancreatitis can be provoked experimentally in animals by either chemical, mechanical, or bacterial agencies. In man, clinical observations but corroborate the deductions from animal experimentation, while the anatomical arrangement of structures brings into close relation with the pancreas not one only, but all, of the possible causal agencies. In the bile flowing through the common duct and, under favorable circumstances, liable to retrojection into the pancreatic duct, is

found the chemical agent. The presence of gall-stones in the ampulla of Vater, or in the pancreatic portion of the common duct, exerting obstructive pressure upon the duct of Wirsung, affords the mechanical agent. The existence of bacteria in the ducts of Wirsung and of Santorini, in the common bile-duct and in the duodenum, all of which structures freely communicate, furnishes the third, which might well be called the explosive agent.

That the injection of bile or bile salts into the pancreatic duct in lower animals will cause an acute pancreatitis, has been conclusively shown by Opie and others. Flexner has carried these experiments further, demonstrating that the intensity of the pancreatic inflammation is dependent upon the concentration or dilution of the salts in the bile. Pure bile, undiluted by mucus, invariably produced an acute pancreatitis, while bile containing a large increment of mucus, as found in chronic inflammatory diseases of the bile tract, produced a chronic pancreatitis.

Opie reports the autopsy findings of a most interesting case of acute pancreatitis in man, in which a small gall-stone, lodged in the ampulla of Vater, while too small to obstruct the opening either of the common duct or of the duct of Wirsung into the ampulla, was still sufficiently large to obstruct completely the outlet of the ampulla into the duodenum. Bile, unable to escape from the ampulla into the duodenum, over-coming the intrapancreatic pressure, was retrojected into the pancreas through the duct of Wirsung, as was shown by the deep staining of the duct walls. In this case all conditions necessary to the production of an acute pancreatitis were present—the chemical irritant in the bile, the mechanical obstruction by the impacted gall-stone, the bacteria from pancreatic and bile-ducts powerful to infect the pent-up secretions and the tissues made less resistant by the pressure therefrom. That this peculiar form of obstruction cannot frequently occur is granted, yet the presence of a gall-stone in the ampulla, necessitating a transduodenal choledochotomy, is by no means rare, a number of such cases having come under my own observa-

tion; and it is fair to suppose that, while the majority will by pressure produce complete obstruction of the common duct, a small proportion will allow the reflux of bile into the pancreas.

Experimental obstruction of the pancreatic duct by ligature has repeatedly produced pancreatitis in animals, and we see the analogue in man in the cases of practically complete obstruction of the duct of Wirsung by a gall-stone lodged in the pancreatic portion of the common duct or in the ampulla of Vater; and it is this calculous obstruction which is, comparatively speaking, so frequently found associated with and productive of pancreatitis. Following the obstruction, an infection of the imprisoned fluids, of the structures of the duct, and, eventually, of the gland itself, ensues and continues as long as the obstruction remains.

When, as described in the early part of this paper, the common duct and the pancreatic duct unite to form a common channel some distance before opening into the duodenum, not only is the outflow of pancreatic fluid arrested by the impaction of a gall-stone in this common channel, but also the retrojection of bile into the pancreas is rendered unavoidable.

It is to Robson that we are indebted for the first exposition of the fact that pancreatitis is so frequently dependent upon cholelithiasis and so generally amenable to surgical treatment, primarily directed toward the gall-stones and the attendant cholangeitis. Recording his own experience, he states that he has found pancreatitis present in about 60 per cent. of the cases in which gall-stones were present in the common duct. The Mayos found 81 per cent. of their cases of pancreatic disease to be the result of or coincident with gall-stones. Deaver reports that the majority of his cases of chronic pancreatitis occurred in patients in whom no gall-stones were present at the time of operation, but in whom there were indubitable evidences of infection of the gall tract resulting in cholangeitis, cholecystitis, or pericholecystic adhesions.

It has been shown that, in an uncertain number of instances, the duct of Santorini opens by one extremity into the duodenum and by the other into the duct of Wirsung. Desjardins

has proven that the duct of Santorini, when patent and normally situated and related, is but a tideway, the direction of the current through it changing from time to time, now flowing from the pancreas into the duodenum and again in a reverse direction from the duodenum into the duct of Wirsung and the pancreas. This reverse current carries with it bacteria from the duodenum through the head of the pancreas and pours them into the duct of Wirsung where, meeting the outbound current in that duct, they are returned to the duodenum by another route through the head of the pancreas. Infection of that portion of the pancreas lying in the triangle bounded by the two ducts and the duodenum is thus rendered possible.

Williams and Bush, basing the deduction upon anatomical study and experimental investigation, suggest "that some cases of acute pancreatitis may be caused by regurgitation of duodenal contents into the diverticulum of Vater, the way having been opened by the passage of gall-stones."

Maugaret contends that pancreatitis following cholelithiasis is not the result, either directly or indirectly, of an intestinal infection; that the infection does not invade the pancreas through the ducts, because of the bactericidal power of the pancreatic juice and the rapidity of the out-current in the ducts; that in very exceptional cases only does the infection extend to the pancreas by contiguity; that infection of the gall-bladder is the one constant condition in associated cholelithiasis and pancreatitis; and that infection is carried from the gall-bladder to the pancreas by the efferent lymphatics of the gall-bladder which terminate in the lymphatic glands at the head of the pancreas, which also receive the efferent lymphatics from the pancreas.

The interstitial changes occurring in the course of a chronic pancreatitis present two distinct types which, depending upon the relative location of the fibrosis, have been termed by Opie the interlobular and the interacinar. In the interlobular form of the disease the fibrosis, primarily between the lobules and not then affecting the intralobular structures, gradually ex-

tends inward from the periphery of the lobules. The affected portion of the gland is given a more distinct appearance of lobulation, and, because of the marked increase of connective tissue, it becomes decidedly enlarged and hard and unyielding to the touch. It is not until late in its progress that the morbid process involves the islands of Langerhans and diabetes supervenes.

The interacinar type is marked by the formation of a network of fibrous tissue within the lobules and surrounding the glandular acini. Involvement of the islands of Langerhans, with the resultant diabetes, is an early event in this form of pancreatitis. The interlobular structures are affected but slightly, if at all, and the affected portion of the pancreas does not usually become nodular, but remains uniformly smooth.

Because of the fact that 62 per cent. of the cases of cancer of the pancreas occur in the head of the organ, because cancer results in decided enlargement, distinct lobulation, and marked hardening of the glandular structures, and because surgeons have failed to recognize that in many instances the enlargement, lobulation, and hardening of the head of the gland was inflammatory, many cases of chronic pancreatitis of the interlobular type have been mistaken for cancer. Attention was first called to this point by Robson in 1900, and his contention has since been verified by a number of operators.

Blocking of the pancreatic duct by pancreatic calculi has been mentioned by some authors as a cause of pancreatitis. Reasoning from the premise that obstruction of the pancreatic duct will result in pancreatitis, this deduction would seem to be justifiable. However, Pende has shown that experimental aseptic ligation of the pancreatic duct will result in the formation of pancreatic calculi having the same chemical composition as the calculi found in man, while Galippe and Guidiceandra have demonstrated the presence of bacteria in pancreatic calculi. It would seem the more correct reasoning, to hold that a pancreatitis, of obstructive and bacterial origin, preceded and was the active factor in the formation of calculi; or that the development of a pancreatitis and the formation of

calculi were synchronous phenomena resulting from the same cause; and that, in either event, the two conditions later became correlated, the obstruction and irritation of the ducts by the calculi still further aggravating the pancreatic inflammation.

That obstruction of the common bile-duct may occur without subsequently provoking a pancreatitis would seem, at first thought, to invalidate some of the contentions herein advanced. Reference, however, to the anatomical relations existing between the common bile-duct and the head of the pancreas, and to the relations between the common and pancreatic ducts, to the methods of termination of the ducts at their duodenal orifices, and to the functional importance of the duct of Santorini, at once explains this seeming discrepancy. As has been shown by Helly, the common duct lies in a groove, uncovered by pancreatic tissue, in 37.5 per cent. of individuals. Naturally, a gall-stone lodged in a common duct running in such a groove, exerting its pressure in the line of least resistance, would fail to compress a pancreatic duct embraced in the substance of the pancreas and, consequently, would not act as a mechanical cause of pancreatitis. When, as in the third and fourth divisions of Letulle's classification, the common duct and the pancreatic duct open into the duodenum by separate but adjacent orifices, a gall-stone obstructing the bile-duct could scarcely occlude by its pressure the pancreatic duct. Again, in a certain small proportion of cases, the duct of Santorini is the main excretory duct of the pancreas, while in others, although of secondary importance, the fact that it opens into the duodenum by one extremity and frequently anastomoses with the duct of Wirsung by the other, enables it to furnish an efficient outlet for the pancreatic fluid when the duct of Wirsung is compressed by a concretion in the common duct, and so annul the otherwise etiological power of obstruction of the latter. However, as the common duct runs through the head of the pancreas, being completely embraced by the gland, in 62.5 per cent. of all individuals, bringing it into close relation with the pancreatic duct, and as the common

duct and the pancreatic duct open into a diverticulum of Vater in the majority of cases, the opportunities for obstruction of the pancreatic duct by gall-stones are indeed great.

As regards the etiology and pathology of retention cysts of the pancreas, the evacuation and drainage of which has to so large an extent constituted the pancreatic surgery of the past, some uncertainty still exists. The late Nicholas Senn advanced the reasonable hypothesis, that as intermittent and not permanent obstruction of the ureter resulted in hydronephrosis, so an intermittent obstruction of the pancreatic duct might produce a retention cyst of the pancreas. Cysts of the pancreas and pancreatic calculi are frequently found associated, but the association is not a correlation, as neither is etiologically dependent upon the other, but both are equally dependent upon a common underlying pathological condition. In the opinion of Robson, chronic pancreatitis is frequently and commonly this underlying condition.

The diagnosis of pancreatitis, either acute or chronic, is not difficult if advantage is taken of all the methods of diagnosis now available. Some of these essential diagnostic procedures are, however, laborious and time-consuming. In the past, difficulties arose because of the slight evidences of digestive disturbances in pancreatic disease, owing to the fact that other agencies were capable of taking on, to a large extent, the functions of the pancreatic fluid. Further difficulties arose from the almost universal association with pancreatitis of morbid processes in the bile tract, the stomach, or the duodenum, the symptoms of the associated processes being at times impossible of differentiation. At the present time, the information obtained from the physical, chemical, and microscopical examination of the fæces and urine, in addition to other signs and symptoms, makes possible the differentiation of the symptoms attributable to each of the associated processes and renders the diagnosis of an existing pancreatitis a certainty.

The digestive disturbances attending a pancreatitis are too indefinite to be of diagnostic value. Loss of appetite, with a particular distaste for meats and fats, is frequently noticed.

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Vomiting is a common symptom in acute pancreatitis and an uncommon one in the chronic disease. The valuable symptoms arising from faulty digestion are found in the altered condition of the fæces. The fecal evacuations in pancreatic disease are frequent, soft, bulky, and pale. One of my patients had, regularly, from three to four large, soft evacuations daily. Patients will frequently complain of diarrhœa, but investigation will generally show that the term has been misapplied, it having been used because the stools were large, soft, and frequent. The importance of this symptom is greatly increased if jaundice is present. In cancer of the pancreas this symptom is not so common as in pancreatitis. In some instances, especially if the ingestion of fats is not diminished, the stools are distinctly greasy. The large size of the stool is the result of incomplete digestion, especially of albuminous foods. The frequency of the evacuations is due to their increased bulk. The normal pigmentation of the fæces being due to the presence of an insoluble pigment resulting from the action of the pancreatic juice upon some of the coloring matters of the bile, it necessarily follows that absence from the bowel of either pancreatic juice or bile will result in unpigmented fæces.

Azatorrhœa, or the presence in the fæces of a marked and unusual quantity of undigested muscle-fibres, is a valuable symptom in pancreatic disease, but is more strongly suggestive of malignant disease than of inflammation. While the undigested meat-fibres may occasionally be detected by the naked eye, a microscopical examination is generally necessary. In weighing the exact diagnostic value of azatorrhœa, the habits of the patient as regards the quantity of meats ingested must be taken into consideration, as undigested muscle-fibres can be found in the fæces of healthy individuals who habitually partake freely of meats.

Steatorrhœa, fat in the fæces, has long been recognized as a symptom of pancreatic disease and is a more trustworthy symptom than is azatorrhœa. Although in some cases of pancreatic disease the fæces are visibly greasy, the presence or absence of steatorrhœa must not be presumed, ordinarily, from

the visual appearance of the stool, but must be determined by a thorough chemical examination. As confirmatory of the pancreatic origin of steatorrhœa, in any given case, the marked diminution in the quantity of fat in the stools following the administration of pancreatic extract is of considerable value.

In the presence of an enteritis, during which ingested materials are hurried through the intestines with more than normal rapidity, both azatorrhœa and steatorrhœa may be present with no pancreatic lesion. This possibility, as well as the habits of the patient as regards the ingestion of fats and meats must be given due weight in arriving at a diagnosis.

The existence of pancreatic disease having been established, the differential diagnosis between cancer and inflammation of the organ immediately assumes importance. Again, resort must be had to chemical examination of the fæces, for purposes of differentiation. In cancer of the head of the pancreas owing to the complete or nearly complete exclusion of the bile from the intestine, resulting from the obstructive gripping of the common bile-duct by the malignant growth, the fæces will be found free from or showing but the slightest trace of stercobilin. In obstruction of the common duct by gall-stone, or in swelling of the head of the gland in chronic pancreatitis, however, the obstruction to the outflow of bile is rarely either absolute or continuous, and stercobilin will be found in the fæces, although in diminished quantity.

Cammidge's pancreatic reaction when obtained in the urine is strongly, if not absolutely, confirmatory of the diagnosis of pancreatitis. No one symptom is so reliable as is this and, when considered in connection with the results obtained from examination of the fæces, it proves of inestimable value. It is, technically, somewhat difficult and tedious of performance, and technical errors must be absolutely excluded, as otherwise failure to obtain the reaction will result in an incorrect diagnosis. The technic of the test is too long and too complicated to warrant its presentation in this connection. While this reaction can be obtained in practically all cases of pancreatitis, it will be obtained, also, in about 25 per cent.

of the cases of cancer of the pancreas, owing to an associated pancreatitis. This possible error in diagnosis can be corrected by examination of the fæces for stercobilin, the absence of the latter in the presence of the pancreatic reaction indicating the existence of cancer of the pancreas.

Loss in weight, due to digestive disturbances and to derangements of internal metabolism, is a rather constant and important symptom of pancreatitis, yet it may not be marked or may be entirely absent. Taken in connection with other symptoms, this loss of weight is strongly confirmatory evidence of either inflammation or malignant disease. As would naturally be expected, it is present to a more marked degree in the latter.

Jaundice in the course of a pancreatitis may be of either biliary or pancreatic origin. The former results from obstruction of the common duct by stone without interference with the outflow of the pancreatic secretion. The latter, far more frequent than the former, may be occasioned by either a catarrhal pancreatitis so frequently resulting from a duodenal infection, or by compression of the common duct as it courses through the head of the pancreas, such compression being due to the enlargement of cancer or the swelling of inflammation.

Courvoisier's law that: "In cases of chronic jaundice due to blockage of the common duct a contraction of the gall-bladder signifies that the obstruction is due to stone; a dilatation of the gall-bladder, that the obstruction is due to other than stone," finds abundant proof in cases of pronounced pancreatic jaundice. That this law has been so distorted by some writers as to convey the impression that with dilatation of the gall-bladder the obstruction is due to cancer of the pancreas, is most misleading and unfortunate. The swelling of the head of the pancreas incident to pancreatitis can as surely result in obstruction of the common duct as can cancer. Moynihan, in this connection, says: "In several cases I have seen a chronic indurative pancreatitis produce jaundice with an enlarged gall-bladder." In one of my own recent cases of obstruction of the common duct from pancreatitis, the distended gall-bladder measured seven inches in length.

In those cases in which the common duct runs along a groove on the head of the pancreas, where it is comparatively free from compression, neither pancreatitis nor cancer will result in jaundice.

The decided tendency to hemorrhage in the course of pancreatic disease, already referred to, need not again be mentioned, except to emphasize its importance as a diagnostic measure.

Pain and tenderness may be pronounced in all the forms of pancreatitis, or they may be at all times absent. In acute pancreatitis both are well marked and the pain may be agonizing in character. The point of tenderness is from an inch to an inch and one-half above and to the right of the umbilicus. In hemorrhagic pancreatitis the pain is frequently of a colicky nature and paroxysmal in occurrence. Each paroxysm of colicky pain probably indicates an additional hemorrhage. In chronic pancreatitis, pain and tenderness are not so strongly in evidence but are generally present. In my own cases, I have never failed to elicit tenderness at the above-mentioned point; and some of my patients, when told to point out the exact seat of pain, have accurately outlined the location of the pancreas from the concavity of the duodenum to the spleen.

Only in exceptional cases have I been able to outline a tumor at the site of the head of the pancreas, although occasionally it can be done. In acute pancreatitis, especially in the hemorrhagic form, the tumor is generally palpable by gentle flat-hand examination. In one case, in which there was marked gastroptosis, at least two-thirds of the pancreas was easily palpable. In the chronic form of the disease, however, the definition of a tumor is always difficult and frequently impossible.

Inflammation of the pancreas may occur as a process limited to the pancreatic ducts or as one involving the parenchyma of the organ, the first frequently being but initiatory to the second. Inflammation of the ducts is observed as either an acute or chronic simple catarrhal inflammation which may, unless resolution takes place, terminate in the more active and

dangerous form of suppurative catarrh of the ducts, or, by extension to the interstitial structures, eventuate in a chronic interlobular pancreatitis. Catarrh of the ducts may be caused by an infection from the duodenum in a duodenal or gastroduodenal catarrh, from extension by continuity of a similar catarrhal process from the bile-ducts, or from obstruction of the pancreatic duct by a peripatetic gall-stone temporarily lodged in the pancreatic portion of the duct. Unquestionably, in many instances, the jaundice so generally called catarrhal jaundice and so generally attributed to infection or obstruction of the bile-ducts by stone, is due to catarrhal inflammation of the pancreatic ducts, the swelling of the head of the pancreas resulting therefrom encroaching upon the common duct and interfering with, but not arresting, the outflow of bile.

Should this simple catarrhal condition result in the suppurative form, the bile-ducts become involved by continuity of structure and a suppurative cholangeitis supervenes. More frequently, the cause not being removed, the infection continues mildly active and, invading the deeper tissues, results in a chronic pancreatitis.

That a primary catarrh of the ducts and, later, a secondary chronic pancreatitis may occur from infection from the bile tract without obstruction of the common duct by stone, must not be forgotten. While, in the great majority of instances, chronic pancreatitis is occasioned by obstruction of the pancreatic duct from pressure by a gall-stone with an infection of the imprisoned fluids, this obstruction is not an etiological necessity. Gall-stones in any part of the biliary tract, causing a cholangeitis, may be responsible for the occurrence of a pancreatitis. These facts are well shown by Deaver's experience, which has been the experience of others, in that in the majority of his cases of chronic pancreatitis no stone was found in any portion of the bile tract, although inflammatory conditions resulting from the irritation of stones sometime present were plainly evident. In these cases a stone may have been temporarily lodged in the common duct, occluding by pressure the pancreatic duct sufficiently long to produce a pancreatitis me-

chanically which continued after dislodgment and escape of the impacted stone.

The parenchymatous inflammations may be either acute, subacute, or chronic. Acute pancreatitis is essentially a hemorrhagic pancreatitis. Gangrenous or diffusely suppurative changes may be engrafted upon the hemorrhagic process. Considerable discussion has taken place concerning the relative incidence of the hemorrhage and the inflammation. Some operators contend that hemorrhage precedes inflammation, others that hemorrhage follows and is but incidental to the inflammation, while still others, as does Robson, believe that hemorrhage may, in some ultra-acute cases, precede inflammation, while in others it follows. From an operative standpoint these points of discussion, while interesting, are of but minor importance.

The symptoms of acute hemorrhagic pancreatitis are those of acute peritonitis involving the upper abdomen, and may readily be mistaken for those of perforation of the stomach or duodenum or of rupture of the gall-bladder. Pain, sudden, severe, paroxysmal, and increased upon movement, limited, in the early stages at least, to the epigastric region, is present. Tenderness is marked in the midline and to the right thereof, just above the umbilicus. Rigidity of muscle was absent, as a rule, in Moynihan's cases, but Ochsner notes it as present in his cases, while it was well marked in my own. Faintness and collapse are early evident and are later followed by vomiting of food, bile, and altered blood. Constipation is present but is more apparent than real, as bowel evacuation and the passage of flatus can generally be secured following the administration of enemata. The pulse is rapid, the rate steadily increasing from the onset of symptoms, as pointed out by Moynihan. The temperature varies considerably in different cases, ranging from a point below normal to one several degrees above. Opie states that " fever is rarely present until secondary changes have occurred in the diseased gland," the inference being that the temperature is due to these changes rather than to the pancreatitis itself. Cammidge's pancreatic

reaction can be obtained in the urine and may be the determining factor in a differential diagnosis. Moynihan says: "In two out of three cases upon which I have operated the most striking feature has been the general lividity of the skin; the face has looked suffused, the lips blue, and the body surface has been damp, cold, and leaden-hued." Opie and Ochsner have also observed cyanosis as a symptom, while Halsted has called attention to the cyanosis not only of the face but also of the abdominal wall.

A history of preceding attacks of gall-stone colic and a cholangeitis, attended in its later stages by jaundice, can almost invariably be obtained. This history taken together with the presenting symptoms makes a diagnosis of acute hemorrhagic pancreatitis strongly presumptive, and when Cammidge's pancreatic reaction is obtained, the diagnosis becomes positive.

Exploratory abdominal section is always indicated and must be performed early. In my own two cases of hemorrhagic pancreatitis a correct diagnosis was made in one case, and that of perforation of the duodenum from ulcer was made in the other. One, the first, was operated upon successfully, while the second died.

An uncertain number of cases of hemorrhagic pancreatitis are not attended by such pronounced and urgent symptoms, and they, naturally, offer a better prospect of success following surgical intervention. Collapse is not so marked, the pulse is neither so rapid nor so weak, nor does death ensue so quickly. These cases can well be classified as subacute.

The one great and essential feature in the surgical treatment of acute hemorrhagic pancreatitis is the provision for rapid, continuous, and abundant drainage. The method of approach to the pancreas must be determined by the conditions presenting when the abdomen is opened. The gastrohepatic omentum may be incised, as in my own cases, or entrance may be effected through the gastrocolic omentum. Approach through the mesocolon will scarcely ever be advisable because the subsequent drainage will be poor. Stab drainage in the costo-

vertebral angle may be advisable, especially in the cases attended by suppuration. Ordinarily, the necessity for this procedure will be obviated by careful exclusion of the general peritoneal cavity by gauze swabs during the performance of the operation and the employment of abundant gauze drainage subsequently. Puncture or incision of the engorged pancreas may be employed to advantage, but the hemorrhage resulting therefrom will certainly be profuse and difficult of control. The incision in the pancreas may be packed with gauze held in place by catgut stitches or it may be closed by catgut stitches alone. Care must be exercised in the control of this hemorrhage by suture that the secretory ducts of the pancreas be not included in the suture, otherwise an obstructive element is at once introduced which must, necessarily, greatly complicate the subsequent course of the disease. The general treatment of hemorrhage, shock, collapse, and infection must follow the customary methods.

The pathology, etiology, and diagnosis of chronic pancreatitis, having been sufficiently considered in the early pages of this paper, will not require further mention. The treatment of chronic pancreatitis is the surgical removal of the cause or causes. Gall-stones residing in any portion of the biliary tract must be removed, and efficient drainage provided and maintained until the existing infection has disappeared.

Gall-stones lodged in the ampulla of Vater can be removed by the McBurney transduodenal choledochotomy. When lodged in the first or second portions of the common duct, direct incision of the duct must be chosen in preference to manipulation and attempted dislodgment of the stone. If the stone is impacted in the pancreatic portion of the duct it can be approached by mobilizing the duodenum, displacing it inward, and separating the loose connective tissue posterior to the head of the pancreas and lifting the latter forward. The discovery of one stone impacted in the duct does not preclude the presence of others, either in the ducts, the ampulla, or the gall-bladder, and most thorough exploration of the entire gall tract must be made in every instance.

Subsequent drainage of the biliary tract is essential to success. Whether this drainage is to be temporary or permanent will depend upon the degree of infection in the bile and pancreatic channels and the severity of the pancreatitis, as evidenced by the amount of swelling of the head of the pancreas and the degree of common-duct obstruction produced thereby. When the infection in the ducts is mild, when the swelling of the head of the pancreas is but slight, and when gall-stones are present, temporary drainage is indicated. This may be obtained by drainage of the gall-bladder by a cholecystostomy, or, when either the supraduodenal or the retroduodenal portions of the common duct have been incised for the removal of a calculus, by direct drainage of the duct by means of a rubber drainage tube carried into the duct and directed toward the liver.

In the majority of instances, however, especially when no calculi are found in any portion of the biliary tract, because of the uncertain length of time during which temporary drainage may persist, and because of the chronically persistent changes in the pancreas—changes which may not disappear and which are obstructive in their nature—permanent rather than temporary drainage must be provided. This is accomplished by the performance of a cholecystenterostomy or, more correctly speaking, a cholecystoduodenostomy, for the duodenum, rather than a lower portion of the bowel, should, whenever possible, be selected for the site of anastomosis. By anastomosing the gall-bladder with the duodenum the bile continues to be poured into the intestinal tract close to the outlet of the stomach, where the escaping stomach contents are early mixed therewith, as is nature's intention and provision. Of great subsequent importance is the fact that the danger of retrograde infection of the gall-bladder and ducts from the intestine is reduced to the minimum by selecting the duodenum as the site for anastomosis.

In the performance of any and of all of these operations the fact that the bile tract and its contents are highly infectious must never be forgotten. The peritoneal cavity must

be especially well walled off by means of gauze pads. Before incising the gall-bladder it should be isolated from the surrounding structures by rubber tissue, as a dentist isolates a tooth. Abundant drainage will frequently be called for and can be assured by the employment of a split tube or tubes.

In conclusion, I would submit: That pancreatitis is of far more frequent occurrence than has been believed in the past; that it is a disease progressive in its nature and tending to a fatal termination; that it can, with the present methods at our command, be diagnosed without difficulty; that it is in the great majority of instances, secondary to, and dependent upon, cholelithiasis or infection of the biliary tract; that it can be cured, or its progress stayed, by the early removal of its causes and the prevention of their recurrence; that, its presence having been demonstrated, the immediate removal of its cause is imperative; that sodium phosphate, olive oil, neglect, delay, and optimistic indifference in the treatment of gall-stones must give way to prompt, radical, and efficient surgical intervention.

THE ADVANTAGE OF SIMPLICITY IN OPERATIONS FOR APPENDICITIS.

BY CHARLES N. DOWD, M.D.,

OF NEW YORK,

Attending Surgeon to the General Memorial Hospital and St. Mary's Free Hospital for Children; Adjunct Professsor of Clinical Surgery in Columbia University.

NOT many years ago the current teaching indicated that a " surgical procedure " was one which was done under the guidance of the eye, any operation not so done being characterized as " unsurgical." Since large wounds " heal as quickly as small ones," it was believed that the best results were to be obtained by making extensive dissections and inspecting the field of operation at each stage of its progress. This teaching, although sound in general principle, has been much modified: the appreciation of cleavage layers often obviates the necessity of extensive dissections, and patients have really been found to do best when the surgical procedure is thoroughly accomplished, with the minimum of tissue disturbance.

The surgical treatment of appendicitis was developed on the basis of the older teaching; it was believed that large incisions should be made, that the intestines should be walled back by gauze pads, that the entire appendical area should be inspected, that all possible local evidences of inflammation should be removed, and that the adjoining parts of the intestinal peritoneum should be treated with more or less vigor. The procedures have been simplified in general surgical practice so that the average appendicitis operation of to-day probably represents less than one-quarter the tissue disturbance which it did fifteen years ago. It would be difficult to

enumerate the authors who have helped to effect this change, but Dr. Robert T. Morris of this city was surely a pioneer, and Drs. Hotchkiss, Stimson and Lilienthal have made contributions of very great value, while Drs. Murphy and Ochsner of Chicago, and the Drs. Mayo of Rochester, Minn., have emphasized and developed the details of the principle with the vast wealth of material at their disposal. In the very extensive literature which bears on the subject one can find an increasing tendency to trust the peritoneum to care for the moderate grades of inflammation which are at a distance from the appendix, and to relieve the local appendical inflammation in the simplest possible way.

Since, however, there are still many surgeons who adhere more or less to the older method, the writer ventures to add another small contribution to the subject in recording the last 110 cases which have been operated upon in his service in the General Memorial Hospital, in St. Mary's Free Hospital for Children and in private practice. The series includes all the operations for appendicitis since September, 1907.

The tabulation was done by Dr. Charles E. Farr. Eighty-eight of the operations were done by the writer, seven by his associate, Dr. Mathews, and fifteen by other members of the assistant or house staff under the writer's personal supervision.

Patients are not included from whom practically normal appendices were removed in the course of operation for other conditions. In one sense, the series was a selected one; in another sense not. Owing to the character of the St. Mary's Hospital service, forty-four of the patients were under fifteen years of age. Owing to the character of the General Memorial Hospital service, patients were not sent there in the last stages of general peritonitis, as frequently happens in the larger general hospitals. Operation, however, in either of the hospitals or in private practice, was not refused to any applicant who had appendicitis. The series represents the cases as they came, without personal selection. There was no mortality among them; they all left the hospital or their sick beds in apparently good condition; their wounds were either com-

pletely healed at the time of discharge or were so healed soon afterward.

(June 21 : Ten more cases have been operated upon without mortality, one too recently for prognosis, the others either in good health or in various stages of satisfactory convalescence. A patient who had left the hospital with her wound healed, and had enjoyed good health for three weeks after reaching home, developed febrile symptoms, without any symptoms of abdominal disease, and died—of pulmonary disease, the attending physician believes. This case is not counted as an operative mortality since both attending and consulting physicians have stated definitely that the symptoms were not abdominal but were pulmonary. She is referred to, however, as it is the writer's wish to represent the series exactly as it is.)

This freedom from mortality is not referred to as remarkable; many operators have had long series of similarly good results. The credit is largely due to the physicians who now so generally send the patients to the hospital before general peritonitis has been established.

The tables show that 24 cases were operated upon in the '' interval," and that 22 were classed as chronic cases, having appendical constrictions, adhesions or other abnormalities which caused persistent symptoms. In the remaining 64 more acute cases the duration of time between the onset of symptoms and the operation has been tabulated as follows:

Operation in the first day............................12 cases
Operation in the second day.......................16 cases
Operation in the third day.........................16 cases
Operation in the fourth day....................... 2 cases
Operation in the fifth day........................ 1 case
Operation in the sixth day........................ 1 case
Operation in the seventh day...................... 4 cases
Operation in the eighth day....................... 5 cases
Operation in the tenth day........................ 2 cases
Operation in the eleventh day..................... 1 case
Operation in the twelfth day...................... 3 cases
Operation in the twenty-third day................. 1 case

These patients were purulent in greater or less degree, some of them to a very great degree. It is particularly in

their group that differences in surgical procedure exist and are important.

The method which has been used for them has been (1) removal of the appendix (if it could be easily reached) by the simplest available method; (2) drainage of the appendical site if pus was there; (3) neglect of the rest of the peritoneal cavity (excepting as the previously mentioned drainage opening provided an exit for its seropus during the first few hours after operation).

1. Under the first of these headings the following details of technic may be referred to: McBurney's incision placed well toward the side, so as to avoid unnecessary contact with the small intestine; size of incision, as small as will furnish satisfactory access to the appendical site, thus avoiding the intestinal exposure which so often accompanies large incisions; avoidance of pads, as far as possible, and use of broad retractors for holding back the intestines; following of longitudinal cæcal bands by aid of plain thumb forceps if appendix is not otherwise reached; separation of appendix from its bed of adhesions by fingers, often out of sight, sometimes aided by traction of aneurism needle passed through base of mesenteriolum; grasp of mesenteriolum by Ferguson clamp when possible, thus facilitating movement of, and access to, the cæcal end. The retractors can then usually be released and the appendix removed and its stump ligated and suitably treated within the walls of the incision and well away from the remainder of the peritoneum.

2. *Drainage.*—In providing for drainage of the appendical site, disturbance of the exudate which lines the abscess wall is avoided, the pus is simply taken up by gauze as it exudes. Soft rubber tubes, or gauze protected by rubber dam, are inserted and secured in position and a portion of the wound closed. Absorbent moist gauze dressings are changed twice daily for the first two days, then less frequently.

3. *General Peritoneum.*—The treatment of that portion of the peritoneum which is at a distance from the appendical site and certain other details may be best considered in referring to illustrative cases.

CASE I.—*Localized abscess; much seropus in general abdominal cavity. Abscess drained; general abdomen disregarded.* C. S., æt. 13, admitted to hospital three days after the onset of a severe attack of acute appendicitis. Temperature, 104°; pulse, 120; looked very ill and had much abdominal rigidity and a palpable mass in appendical region. Leucocyte count, 24,000; polynuclear, 90 per cent.

Incision was made well to the side and the opening of the peritoneum was followed by a gush of seropus. An abscess cavity was found in the cæcal region, which contained a ruptured appendix, concretions and thick foul-smelling pus. The appendix was enucleated from a mass of adhesions by the finger; its stump was ligated with catgut; gauze, protected by rubber tissue, was placed against it as a drain. A moist dressing was applied and she was returned to the ward without further procedure. Semi-erect posture and continuous saline rectal irrigation were used. Food was withheld for thirty-six hours, when a little broth was given. There was an abundant discharge of pus into the dressing and the wound was not entirely healed until five weeks later, but otherwise recovery was uneventful.

This represents a class of cases which has caused much confusion in the consideration of the subject, this confusion depending largely on the interpretation of the seropus (or cloudy serum) which lies free in the peritoneal cavity, and which gushes from the incision when the peritoneum is opened; it is usually almost white. Those who consider it highly infectious pus believe the case to be one of diffuse or general peritonitis, and they will surely find the intestines to be red if they handle them much. Those who believe that this seropus has very slight infective power will disregard it; they are accustomed to see serous effusions after various irritations, *e. g.*, strangulated hernia, early unruptured appendicitis; and know that it can contain many leucocytes without having much infective power, and they know that in cases with old encapsulated appendical abscesses it has largely disappeared. In this particular case, and in others which I have had examined, no culture grew from it. In this series of cases this seropus has been regularly disregarded, although it has often been present in large amount. General peri-

tonitis has not followed in a single instance, and there has been only one secondary abscess to open.

The local abscess about the appendix is of course different. The pus here is usually highly infective, and every effort should be made to protect the general peritoneal cavity from its virulence.

The following case is also illustrative:

CASE II.—*Very long gangrenous appendix lying in middle of abdomen, with no apparent encapsulation. Profound sepsis; appendical tract drained; general abdomen disregarded.* C. S., æt. 51, admitted to General Memorial Hospital after two days of suffering from a very severe attack of gangrenous appendicitis, with severe pain, vomiting, chill and extreme prostration.

On operation the appendix was found to be six inches long, gangrenous throughout its entire length and containing four concretions; its tip lay to the left of the median line. In the patient's critical condition, the manipulation and cutting necessary to gain a complete exposure would surely have been fatal. On following the appendix with the finger, however, it was found to loosen, and was thus enucleated. Before the fingers were removed from the long tract where it had lain, cigarette drains were inserted to its end. The appendix was then removed after its base had been compressed and ligated and the stump cauterized and buried under a purse-string suture. No other treatment was given excepting the postoperative measures already referred to, and the recovery was prompt and uneventful.

There have been many of the severe cases similar to these two, and the prompt way in which they recovered when the appendix was treated in a very simple way, and the rest of the peritoneal cavity was disregarded, has made the writer very confident of the advantage of the method. The results have certainly been very much better than they were under the methods previously used.

The question of *appendix removal* is often an important one. The cases from whom it is not removed at the primary operation are illustrated by the following:

CASE III.—*Appendicitis of twelve days' duration; extensive peritonitis; much pus. Appendix not removed at primary opera-*

tion. E. H., a well-nourished child of 6 years, was brought to St. Mary's Hospital, February 27, 1908. Twelve days previously she had begun to have abdominal pain and to vomit. The vomiting had persisted and for the last few days she had been extremely ill, having much abdominal distention. On admission she presented the picture of extreme depression, with sordes on teeth, abdominal distention, rigidity and tenderness. Pulse, 120; temperature, 103°. Leucocytes, 68,000, 90 per cent. polynuclear.

Incision over the appendical region was made without delay. Much pus escaped. Such intestines as were seen were red, and there was much deposit of fibrin. No distinct abscess wall was evident. The examining finger could detect openings apparently to other parts of the abdomen. The appendix was not evident and no extended effort was made to find it. Her only chance of recovery manifestly lay in taking advantage of such adhesions as had already formed and relieving the site of maximum inflammation. Therefore, soft rubber tubes were simply put through the opening and a voluminous dressing applied. The operative procedure occupied hardly more than five minutes. She was returned to the ward and put in the Fowler position. Saline rectal irrigation was used. The dressings were changed twice daily at first. Food was withheld for twenty-four hours. Then, since she would not take broth, peptonized milk (half ounce, q. 2 h.) was given. During the process of healing sloughs or fibrinous coagula came through the wound, but she made a good recovery, excepting for a hernia, which was repaired in July, when the appendix was also removed.

There have been three cases in the series from whom the appendix was not removed. In work which preceded this series the writer has left it in several times and has had to remove it later in about one-third of the cases.

While considering the subject of protracted search for the appendix, the history of one of the patients of this group may be narrated. She had had a previous operation less than three years ago on the basis of the older teaching. The operation was done in a very good hospital, by an unusually good surgeon; the history was brought to me by the attending physician, and since location hides the identity of both hospital and surgeon, it is given in detail to show how radically a

method of procedure, which was recently in general use and which is still in limited use, differs from the one here advocated.

The usual intermuscular incision, three inches long, was made through the abdominal wall, over the appendix, and the peritoneum opened. The cæcum was found presenting. To this the lower portion of the omentum was adherent, and the whole was bound tightly down with firm adhesions. These were broken up below and beneath the cæcum. A large abscess cavity, well walled off with firm adhesions and filled with thin, yellowish pus with foul odor, was found. The rest of the abdominal cavity having been previously walled off with pads, the pus was washed out with saline and the cavity sponged out. All the bleeding points were clamped and ligated and the contents of the abscess cavity examined. It was impossible to definitely identify the appendix, but a large necrotic and inflammatory mass, about the size of a large hen's egg and believed to contain the organ, was ligated and cut away. The lower portion of the omentum was likewise cut away and a drainage tube of rolled rubber dam was inserted down to the bottom of the abscess cavity. A split rubber tube with gauze wick was placed down to the iliac fossa and two accessory drains of gauze were placed beneath the cæcum. The wound was partially closed.

After the operation intravenous injection of salt solution was given and the temperature ranged around 103° until July 14, one week after the operation, when it touched normal. July 20, again arose to 103° and did not subside until July 25. July 31 a chill and temperature 103° once more, and at least twice the abdomen was searched for pus pockets. One pocket of pus in upper part of incision was found. Warm applications were applied q. 3 h. for several successive days at different periods. Temperature finally remained normal on August 8, and on the eighteenth the patient came home, the wound healing by granulation.

If the abscess had simply been opened and drained the extreme depression which made infusion necessary would certainly have been avoided. The extensive breaking up of adhesions, the use of fluid in the abscess cavity, the extensive exposure and wiping and the dissecting out of the egg-sized mass, were severe traumatisms and infection-spreading procedures. It is easy to believe that they were the cause of the extreme illness and the stormy and prolonged convalescence which followed. Furthermore, they accomplished no good purpose, as the appendix was left in after all and had to be removed at a subsequent operation. It is difficult to appreciate how a low mortality rate can follow this type of procedure.

AN IRRIGATING SOUND OF THE STANDARD AND BENIQUÉ TYPE.

ALSO AN IRRIGATING TUNNELLED AND GROOVED SOUND FOR THE DILATATION
TREATMENT OF STRICTURE OF THE MALE URETHRA.*

BY VICTOR COX PEDERSEN, M.D.

OF NEW YORK.

Genito-urinary Surgeon of the Outpatient Department of the New York Hospital
and House of Relief (Hudson Street Hospital).

UNTOWARD results following the passage of sounds through the male urethra into the bladder are not by any means uncommon, even when there is neither stricture nor deformity of the passage, nor discoverable infection present. The uncertain manner in which the gonococcus lurks in the deep urethra, even after subjective and objective symptoms have disappeared, makes the danger of infecting the bladder the greatest of these unfavorable sequelæ. In a certain number of cases reflex nervous symptoms reaching even the limit of temporary anuria and of more or less severe urethral fever have been reported.

The writer has always had the feeling that the one surely safe procedure lies in filling the bladder with a warm mild antiseptic solution immediately after withdrawing the sound, which will provide against infection of the bladder, as previously stated, and will, by permitting the patient to evacuate this quantity of fluid, tend to correct the dangers of anuria and nervous chill. The antiseptic will furthermore protect against septic urethral fever.

For these reasons during many years the habit of the writer has been to follow the sound with a soft rubber or woven silk catheter by means of which the irrigation of the urethra and the bladder is accomplished. In addition to this, another detail of treatment has in the majority of cases been carried out, namely, to give sthenic patients morphine gr. $\frac{1}{8}$–$\frac{1}{4}$, fluid-

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extract of aconite mimims 2–3, and sulphate of quinine gr. 5–10. For asthenic individuals the medication is changed to codein gr. ½–1, nitroglycerin gr. $^1/_{100}$–$^1/_{50}$, quinine gr. 5–10. These are not "gunshot mixtures," far otherwise: the morphine or the codein allays nervous excitement; the aconite or the nitroglycerin dilates the blood-vessels, thus correcting congestion; and the quinine is an efficient febrifuge. After long experience with these combinations, the writer has still to find anything better for the purposes.

The passing of the catheter, however, has the objection of doubling the instrumentation, which is a decided disadvantage on account of the dangers of infection primarily and secondarily on account of the nervous irritation of the patient in cases, for example, where the sphincter of the bladder passes into slight spasm after withdrawal of the sound. In order to correct these features the writer devised an irrigating sound based primarily on the fact that in order to be readily aseptic the tube in the sound must be perfectly straight and have only end openings, so that a swab might be passed through it easily, if necessary.

After considerable study and experimentation, a sound has been produced (see Fig. 1) which corresponds to the following description from No. 18 F. upward.

The irrigating tube is a silver catheter and is of the same size for the entire series, namely, 10 F. It runs straight through the shaft of the sound from the base of the curve to the nipple at the handle, at which it receives the rubber tube from the irrigator. At first sight this point of emergence at the base of the curve may seem to be incorrect, but actual practice with the sound shows that the necks of most bladders seize the sound just in front of the opening so that the irrigating fluid is delivered exactly where it is most required, namely, upon the floor of the bladder. In a few bladders it is necessary to push the sound in a little further, or to rotate its tip to the right or the left in order to disengage the opening of the tube from the mucous membrane, or to depress the handle of the sound in order to elevate the opening above the bladder floor.

The diameter of the silver catheter, 10 F., is amply large for evacuation of thick contents of the bladder and for irrigation of that viscus with due and normal rapidity.

As to the advantage of delivering the irrigation just within the neck of the bladder and directly upon the bladder floor, attention of the reader is drawn to the double-current irrigating instrument devised by Peterkin,[1] exhibited before the American Urological Association and described in the Transactions of that body, 1909. The instrument consists of the sheath of a cystoscope through which a tightly fitting partition is carried, borne upon a water-tight plug which fits the outer end of the

FIG. 1.
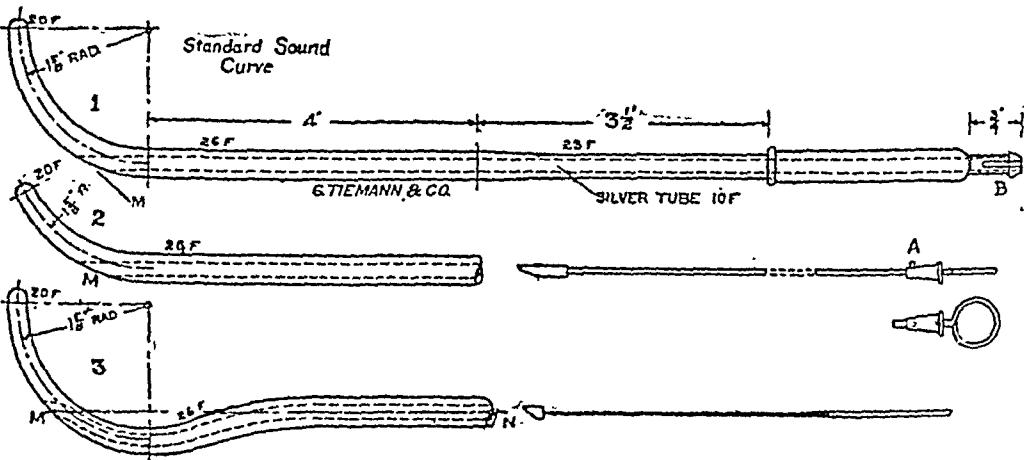
From above downward are shown the sounds with standard, shortened and Beniqué tips. The 6-size taper from straight shaft to point (26-20 F.) is indicated, also the 3-size reduction of Chetwood near the handle (26-23 F.) M points to the bladder outlet of the silver tube (10 F. diameter) and B to the hose-connection, identical for all sizes of the set. In the Beniqué instrument M shows the straight projection forward of the tube to open in the curve at a point just above the bladder floor. A illustrates the obturator. Note the position of the little plug far down the handle of A, to agree with the long slot in B; if the obturator is not properly seated in B the plug will not show at M, thus avoiding the accident of having the sharp point of the obturator project against the urethra and bladder, because this point is shorter than the slot in B.

sheath and itself carries one tube each into both halves of the sheath thus set off by the partition, and thus permitting inflow and outflow after the double-current method.

The nipple is also of uniform size for the entire set and is

tipped with a cone-shaped collar for rubber tubing ⅜ inch in diameter. This uniformity saves a great deal of trouble in making the connections, as this size of rubber tube is that commonly employed on irrigators and hand syringes.

The handle of the sounds is of the shell-like variety commonly seen on many instruments, and does not vary from sound to sound.

The shaft is of the double taper type introduced by Dr. Chetwood.[2] The first 3½ inches next to the handle are three sizes smaller than the main shaft, which then passes forward at full size for 4 inches until the base of the curve is reached, thus making the straight part of the shaft 7½ inches long.

The curve of the sound is on a radius of 1⅝ inches, which is the curve of the nonirrigating standard sound. The length of the curve is a trifle more than 90°, which is also the length of the curve of the nonirrigating standard sound. The taper of the curve is uniformly 6 sizes from the base to the tip, so that, for example, size 26 F. is 20 F. at the beak. In the writer's experience this taper is the most convenient. Some authorities prefer the standard curve but shorten it by about one inch.

Many other authorities prefer the Beniqué curve sound. In case sounds with the Beniqué tipe are to be used, I would suggest that the first 90 degrees of the instrument be tapered 6 sizes, so that, for example, a No. 26 F. instrument is 20 F. at the point. The tunnel should also pass along the curve until it emerges at a point corresponding with a straight line projected through the straight part of the shaft of the instrument until it cuts the curve. Thus a point of emergence is reached which will be just above the bladder floor when the sound is inserted exactly as in the other two forms. Although in the Beniqué sound the tunnel is no longer literally straight, in having only end-openings it may readily be cleansed. The obturator is of the same form as that just described excepting that the first few inches of the shaft are flexible, by being made of flat spring-metal.

The obturator of the sound consists of a small plug ground to fit the opening at the base of the curve of the sound accurately, mounted on a long rigid wire with a loop handle at the other end. A little metal plug fits into the lumen of the nipple, thus steadying the obturator at this point. In order to prevent the obturator

from twisting, a device like a simplified bayonet-catch has been provided between the nipple and the handle of the obturator.

In order to prevent the sharp corner of the obturator seen in *A*, Fig. 1 (made by the obliquity of one surface where it matches the curve of the instrument), from projecting out of the silver tube and thus cutting the patient if it were to be placed in the inverted position in the tube of the instrument, the slot of the bayonet-catch in the nipple has been made very long and the plug on the handle of the obturator has been set forward a corresponding distance. Thus if the obturator is wrongly inserted the plug will prevent the obturator from being seated home at all until it is rotated so that the peg is in the slot.

When the obturator is set, in order to prevent any sharp edges whatsoever, the surface of the obturator has been *convexed* a little and the opening in the silver tube *concaved* a little, thereby preventing sharp edges.

These irrigating standard sounds have been in use by the writer and his colleague, Dr. Walter B. Brouner, for two years, having been devised in 1907.* The Beniqué and standard forms were shown before the Genito-urinary Section of the New York Academy of Medicine at its meeting in December, 1907.

The manner of using the sounds is as follows: After thoroughly boiling, the obturator is examined to see that it is freely movable for final withdrawal and then it is pushed into proper position and locked. The sound is then lubricated and introduced into the urethra in the usual manner. It is well to place the little finger through the loop in the handle of the obturator so as to be sure that the obturator does not slip. For the same reason it is also well to make the final pressure upon the sound by means of the obturator-handle, which is stout enough to permit thereof. After the sound has remained in place the desired five or ten minutes the obturator

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* The dates for the mechanical drawings for these sounds are as follows: irrigating sound, Beniqué curve, March 15, 1907; irrigating sound, standard curve, March 29, 1907; irrigating sound, short curve, December 21, 1907. The drawing for the tunnelled and grooved sound (subsequently described in this monograph) is dated January 27, 1908. This chronology may be of historical value later.

is gently withdrawn. Sometimes a flow of urine follows, especially if the sound has been left in the bladder five minutes or more. A receptacle should therefore be at hand to catch such evacuation.

The irrigator, having previously been filled with the desired warm antiseptic fluid, is now connected to the nipple. The act of attaching the rubber tubing for the irrigator or syringe should be done so gently that chafing or scraping the bladder

FIG. 2.
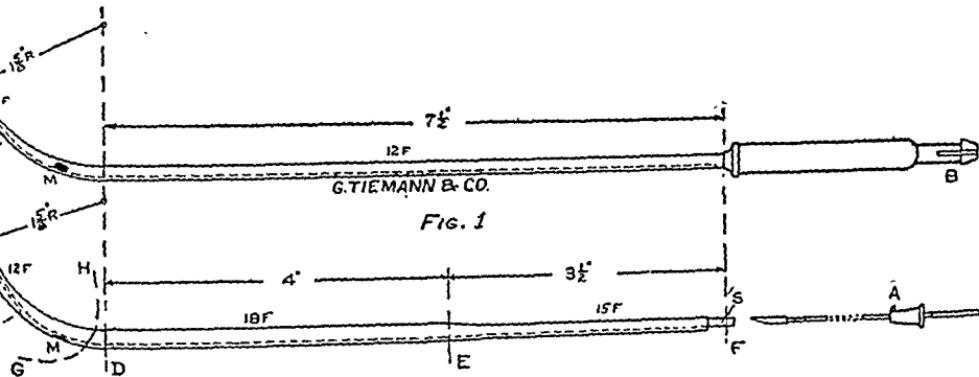
FIG. 1

FIG. 2

Nº⁵ 7,8,9,10,11,12 are made of steel tubing, nickel plated opening on side in order to clear the groove (M, Fig. 1)
Nº⁵ 13,14,15,16,17,18,19,20, open on the convexity of the curve (M. Fig 2)
Nº⁵ 8,9,10,11,12 taper to 7 at the end. In Nos 13,14,15,16,17 the taper is six numbers, uniformly (Fig. 1)
Only Nº 18 and larger are double tapered. In a Nº "N" sound the curved portion i.e between C and D would increase from "N-6" at C to "N" at D. the portion between D and E is of uniform circumference "N"; and the portion between E and F is also of uniform circumference but smaller i.e "N-3" (Fig 2)
In all sizes the diameter of tunnel and groove, the handle, and the rubber hose fitting are the same
Nº 13 and larger have a silver tube (S) which is the same in all sizes, 7 F (Fig 2)
All the above numbers refer to the French scale

floor with the open end of the channel in the sound should not occur. In the writer's experience it is best for this purpose to have a three-inch piece of rubber tube of such size as to slip over the nipple very readily, but water-tight. Into this the conical tip of the syringe or irrigator may be slipped without disturbing the sound. Although apparently simple this is a very important detail.

Under gentle pressure a few ounces of fluid at a time are run into and out of the bladder. If the flow does not immediately start it is probably due to the fact that the mucous membrane of the bladder floor lies too tightly against the

bladder end of the tunnel. Rotation of the sound to right or left will correct this little difficulty. Or, the obstruction may be due to the fact that the sound is not in the bladder quite far enough, which is corrected by pushing it gently onward. If this is suspected, it is better to reintroduce the obturator because the oblique opening of the silver tube at the base of the curve makes the progress of the sound painful in these circumstances. After the bladder has been irrigated it is finally filled with the fluid and the sound without the obturator is withdrawn. The patient is then allowed to evacuate the antiseptic at once or to carry it away with him in his bladder for evacuation a quarter-hour or a half-hour later.

The results of using this sound seem to be emphatically not only a protection against all ordinary dangers of sound passing, but a distinct promotion of the comfort and reassurance to the patient. The writer has had, for example, a number of very intelligent patients who, although from the hands of well-known physicians, have stated that they never have felt so comfortable after the passing of a sound as they do after these irrigations and evacuations of a warm simple antiseptic fluid.

II. AN IRRIGATING TUNNELLED AND GROOVED SOUND FOR THE DILATATION TREATMENT OF STRICTURE OF THE MALE URETHRA.

Without entering into a lengthy discussion of the comparative merits in the treatment of stricture of the male urethra between the methods of dilatation and of internal and external urethrotomy, it is reasonably accurate to say that in the absence of inflammation of the urethra, bladder, and kidneys, which would indicate drainage, dilatation may be applied to most strictures of moderate extent along the length of the urethra through which a filiform guide may be passed. The tendency is to advocate the use of soft instruments in the early stages of dilatation until the halfway point (say 15 F.) has been reached. For the average practitioner this is certainly the safest rule; for the expert, however, who is

always willing to be patient, gentle, and deliberate, rigid instruments are perfectly safe, provided that step by step (say every quarter-inch of advance) the freedom of the filiform guide in the tunnel is always proved by drawing out or pushing in the filiform a little. Many strictures which might require operation, thus taking the patient away from business, may be successfully dilated.

The necessity of always washing out the bladder and urethra after any instrumentation led the writer to devise an irrigating tunnelled and grooved sound laid down on the lines of the original Van Buren-Gouley sound. Hitherto the only

FIG. 3.
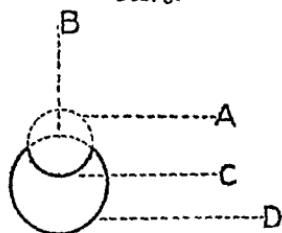
The dotted semicircle *A* indicates the waste of the small tube used to make the groove of the sound. The dark semicircle *C* shows the portion thereof comprising the groove. The dotted line *B* shows the waste of the larger tube cut away to accommodate *C*. The heavy line *D* represents the portion, which brazed together with *C*, makes up the cross-section of the sound.

irrigating instrument which might be used as a sound is the silver catheter, which unfortunately is so soft as to defeat its own purpose in no small number of cases. The writer has devised a tunnelled and grooved sound by taking two steel tubes for the small sizes and by cutting a segment out of the wall of each which when brazed together give the shaft of the sound, *D*, and the groove of the sound, *C* (see Fig. 3).

The smallest size of the series is 7 F. These sizes are taken on the ground that if a stricture will not accept size 7 F. easily it had best be subjected to external urethrotomy, and on the ground that if the stricture accepts sound 7 F. it may be dilated to 8, 9, or 10 F. at the first sitting. It is to be remembered that the guide of the Maissonneuve urethrotome is 7 F. in diameter. This fact led the writer to determine upon the same size as the extreme small limit for the tips of his series of sounds.

In order to preserve the plan of the irrigating standard sounds just described, the curvature is uniformly of 1⅝ inches radius,

the length of the curve is approximately 1 inch shorter than that of the standard sound. To compensate for this shortening of the tip the straight part of the shaft is elongated 1 inch. The taper of the curve is uniformly six French numbers in all sizes from 13 to 20. Sizes 8 to 12, both inclusive, however, taper to No. 7 at the point. By this plan of six-size taper where possible the dilatation is made very gradual. For example, size 18 F. is at the tip 12 F., at the middle of the curve 15 F., and at thirds of the distance between the tip and the middle of the curve 13 and 14 F., respectively, and at thirds of the distance between the midpoint and the straight shaft 16 and 17 F. respectively. Also, for example, size 10 F. is 7 F. at the tip and 8½ F. at the midpoint, and so on for the whole series of sounds. This careful uniformity of taper is of great service in using the sounds, for a stricture which has taken 8 F. will accept almost the half-beak of the 10 F. instrument before the real dilation begins, and a stricture which has taken 16 F. will engage almost two-thirds of the beak of an 18 F. sound before stretching ensues. Thus far greater safety in the use of the instruments is gained.

It is not necessary to have an office set consisting of all sizes. The author has found the even numbers sufficient, namely, 8 to 26 F., inclusive. Ordinarily No. 20 F. would be the largest required. Two patients, however, who refused urethrotomy had dense extensive strictures which required for safety the other numbers of the series stated, namely: 22, 24, and 26 F.

The shafts of the instrument are of uniform size from the base of the curve to the handle until size 18 F. and larger are reached. Then the double-taper plan of Chetwood is used.

The tunnels of the tips are of uniform diameter from the smallest to the largest sounds, namely, a trifle over the diameter of the ordinary whalebone filiform guide. This plan prevents wabbling of the larger sizes upon the filiform and accustoms the operator to a *uniform feel* of the action of the sounds in passing along the guides, also a very important detail. All tunnels are moreover ⅝ inch long, which gives relatively extensive cones for the tips of the sounds. The long-tunnelled tip follows the direction of the filiform better and really prevents the tendency of short tunnels to cut or buckle the filiform.

The grooves begin at the proximal ends of the tunnels and extend throughout the shaft to the handle and are likewise of

uniform width and depth, *i.e.*, large enough to accommodate the standard filiform guide. This excess of space between the filiforms and the grooves is ample for the purposes of urethrotomy, namely, of guiding the knife and the director, should such be necessary.

Irrigation is provided for in sounds No. 13 F. and larger by silver catheters of uniform size (7 F.) extending from the base of the curve of the tip to the rubber hose-fitting in the handle and opening into the groove at the base of the curve. Sizes 7 to 12 (both inclusive) are hollow throughout and in order to clear the groove have the opening on the side also at the base of the curve. This is necessary because a separate silver tube could not be incorporated into such small sizes.

The handles of the sounds, including the hose-connections and the obturators of the sounds, are the duplicates of the types used in the standard sounds described in the first part of the article.

The extreme advantage of this type of irrigating tunnelled and grooved sound lies in the fact that it permits treatment of the bladder through the one and same instrument as is used to dilate the stricture. In other words, instrumentation is halved, *i.e.*, reduced to a minimum, which in most strictures is of extreme importance, because the reflexes due to irritation are matters of moment in all stricture-instrumentation.

In closing this paper it seems well to add a few paragraphs for description of similar sounds which have preceded those of the author. The following historical review, therefore, of dilating and irrigating sounds seems warranted.

Syme's [3] guide appears to have been one of the earliest instruments for passing through stricture. It had no tunnel, but a long small curve shaped like an ordinary sound. The curve and first portion of the shaft were reduced to a small diameter and ended in a shoulder, whence proceeded a straight shaft to the handle. The shaft and tip were grooved as the guide to knife when operating. The tip, however, was so small that doubtless frequent accidents happened, due to the fact that the sharp point had no whalebone guide to make it clear the urethral walls.

G. Frank Lydston [4] says: "The late Professor W. H. Van Buren was the inventor of the first tunnelled instruments ever used and should have due credit for them." Gouley, however, seems to have been the first to

describe the same. According to Van Buren and Keyes,[5] Gouley borrowed his idea from Van Buren. Without entering into a controversy long since passed, it will probably be good judgment to give both men credit and call the first type of tunneled instruments used the Van Buren-Gouley tunnelled and grooved sound, which was described by Gouley[6] in 1864. The original description reads: "It is a grooved conical steel sound with a canal one-eighth of an inch in length at the vesical extremity, and with a curve equal to one-fifth the circumference of a circle three and a quarter inches in diameter. The smallest (No. 3) is one and a half millimetres in diameter at the point. I have had larger ones (to No. 15) made to fully dilate strictures complicated with false passages, and have named them tunnelled sounds. When a capillary whalebone guide has passed through a tortuous or an eccentric stricture and has entered the bladder, the free end is slipped through the tunnel of the smallest sound, which is carried down to the obstacle, held in firm contact with it,—precaution being taken to keep the guide in the groove of the staff,—and in a few moments the instrument will pass, but no force or undue pressure should be used. It is desirable after having accomplished this much, to carry on dilatation rapidly, at the same sitting, to four or five higher numbers, to guard against the possibility of retention of urine from too great inflammatory swelling. The stricture should then be treated by gradual dilatation, and no other method thought of, unless dilatation fails after a thorough trial."

One feature of difference between the Van Buren-Gouley tunnelled instruments and those of the writer is that in the former the tunnels increase in diameter with the increase in the size of the sounds. In the opinion of the writer this is a mistake, because it deprives the operator of a uniform "feel" as to how the instrument is sliding over the filiform, duly provided for in the sounds of the writer by having all the tunnels of the same diameter and length.

Gouley's[7] catheter appeared about 1869 and is thus described: "In 1869 I adapted the tunnelled principle to the one-eyed English gum catheters and have used them with much satisfaction and success. The whalebone guide is passed through the vesical extremity of the instrument, which is open, and out of the eye. Their use is especially indicated when, after having made rapid dilatation of a narrow stricture, it is found necessary to retain a catheter for a few hours."

FIG. 4.
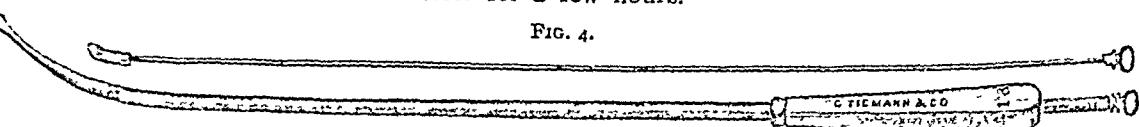
The Gouley[8] catheter staff appeared at about this time. It consisted of a silver tunnelled and grooved catheter with an obturator.

F. N. Otis's[9] dilating catheter was threaded from an opening in the end of the tube to the handle throughout the instrument.

L. B. Bangs's[10] instillating catheter sound was the next advance. It modified the Keys-Ultzmann syringe-sound so as to make the tips attach to the syringe-barrel by a slip-joint. Thus a set of tips comprising any series of sizes could be used. Through a small central tube from handle to tip irrigation of the bladder may be accomplished. The tube, however,

is too small to permit the evacuation of thick bladder contents. The range of tips, however, in the set permits dilatation of the stricture and instillation of healing solutions upon the damaged mucous membrane to be practised with the greatest possible advantage.

About twelve years ago Dr. Willy Meyer [11] exhibited before the New York Academy of Medicine a sound reaching the indications for irrigation of the bladder and devised by Trendelenburg, of which the above is an illustration. It will be noted, however, that the Trendelenburg sound has an olivary tip, a peculiar, open, short curve, and lateral openings, thus, excepting in its purpose, it differs materially from the writer's sound.

This paper cannot be closed without giving credit to C. E. Panoff, M.D., for a sound described in the *New York Medical Journal* of June 12, 1909, in general terms closely like the sounds of the writer. Dr. Panoff states that the dates of the various models are July 23, 1908, Jan. 3, 1909, and May 17, 1909. It will thus be seen that the sounds of the writer were designed and in use more than a year previous to Panoff's.

In Panoff's sound the channel for irrigation is not a silver catheter and does not run through in a straight line to the base of the curve of the tip. The opening of the channel is inferiorly placed about three-quarters of an inch back from the base of the curve, thus requiring a deeper introduction into the bladder than do the sounds of the writer. The experience of Panoff, however, is identical with those who have used the sounds, namely, that the act of voiding artificial urine after instrumentation adds to the comfort of the patient. It is very interesting to see how two persons, unacquainted one with the other, working in the same specialty, should have reached much the same *design of instrument* independently one of the other.

REFERENCES.

[1] Peterkin: Transactions American Urological Association, 1909.

[2] Chetwood and Keyes: Venereal Diseases, 1900, p. 126.

[3] Truax, Charles: Mechanics of Surgery, 1899, p. 594.

[4] Bangs and Hardaway: An American Text-book of Genito-urinary Diseases and Syphilis and Diseases of the Skin, 1899, p. 176. G. Frank Lydston, "Organic Stricture."

[5] Van Buren and Keyes: Genito-urinary Diseases with Syphilis, 1874. Footnotes, pp. 127-129 (both inclusive).

[6] Gouley: Diseases of the Urinary Organs, 1873, p. 53.

[7] *Opus cit.*, p. 54.

[8] *Opus cit.*, p. 124.

[9] Otis, F. N.: Pamphlet 4741, N. Y. Academy of Medicine, p. 15. A Description of the Instruments and Apparatus of the Author with Directions for their use in Operations on the Genito-urinary Organs.

[10] Bangs and Hardaway: *Opus cit.*, 1899, p. 598. James Pedersen, "Impotence."

[11] Meyer, Willy: Roser's Sound and Trendelenburg's Catheter-Sound, N. Y. Medical Journal, 1892, vol. lvi, p. 162-163.

INTRAVENOUS LOCAL ANÆSTHESIA.

BY JAMES MORLEY HITZROT, M.D.,

OF NEW YORK CITY.

BEFORE the 37th Congress of German Surgeons, in April, 1908, Bier (*Archiv. f. klin. Chir.*, Bd. lxxxvi, 1908, p. 1007) presented a method of local anæsthesia by the intravenous route which he had found extremely successful for the resection of joints, tendon transplantation, sequestrotomy, amputations of the various extremities, etc.

The method is applicable only to the extremities and briefly is as follows: The extremity to be operated upon is carefully bandaged with a soft rubber bandage from the distal end to a point sufficiently high to allow free access to the field of operation. This must be so done that all the blood is squeezed out of the extremity and kept out by a broad band above the field of operation. A second rubber bandage is wound about the extremity below the field of operation, enclosing it between the upper and lower bandages. Under infiltration anæsthesia a subcutaneous vein, close to the upper bandage, is exposed, if possible by a vertical incision,—if not, a transverse one will expose a vein without difficulty. The vein is freed, two ligatures passed beneath it, the upper ligature tied, and the vein cut across. An ordinary metal infusion cannula is then passed into the lower (distal) end of the vein and tied over it, firmly closing the vein about the cannula. Through this cannula the operator injects from 50 to 100 c.c. of 0.5 per cent. novocain solution in a direction opposite to the normal blood current. Anæsthesia results in from 5 to 10 minutes, due to the passage of the novocain solution through the vein wall, and is complete. The cannula is left *in situ;* injected solution must not escape.

When the operation is completed and before closing the wound, he washes out the veins with warm salt solution. As an additional precaution the upper rubber bandage is loosened sufficiently to allow the blood to flow through the arteries and thus to wash out still more of the novocain solution. After

the blood has flowed for a few minutes the bandage is again tightened, the wound sponged dry, and closed in the ordinary manner. The dressing is applied and the rubber bandages removed. In amputations the line of the incision passing through the injected area makes the washing out process unnecessary.

The anæsthesia lasts for from 5 to 15 minutes after washing out the veins. In nervous individuals Bier finds a preliminary dose of morphine and scopolamine very satisfactory.

A number of cases suitable for this procedure, in which general anæsthesia was contraindicated or not desired, led me to try it; in each case anæsthesia was complete.

The armamentarium is very simple. A 0.5 per cent. novocain-salt solution is carefully sterilized by boiling. The implements necessary are a silver infusion cannula of the ordinary type, a piece of rubber catheter to connect this with the tip of a glass syringe of the type with asbestos packing known to the trade as the McElroy syringe, large enough to hold 100 c.c.

In applying the rubber bandage to the extremity it causes less discomfort if the main arterial circulation is cut off by digital pressure, the limb elevated, and the bandage then applied from below upward and fastened and the lower turns unrolled. As in an intravenous infusion, the cannula can be more easily placed in the vein if the two ligatures are held taut and a small longitudinal slit made in the vein between them. Into this the cannula may be readily slipped. The upper ligature is tied and the lower one tied carefully about the cannula to prevent leakage, as recommended by Bier.

As the solution is forced in, the subcutaneous veins become prominent and the solution can be seen entering the entire area between the bandages. After a few minutes the veins become less and less prominent and finally are not distinguishable, due to the rapid diffusion of the fluid into the tissues. The remaining steps are those carried out by Bier. The following cases are chosen to illustrate the efficacy of the above method:

CASE I.—*Amputation of Leg for Tuberculosis.*—Male; aged 28 years. Bellevue Hospital, service of Dr. Woolsey; operation February 1, 1909. Morphine, ⅛ gr., one-half hour and another ⅛ gr. fifteen minutes before time set for operation. After the

27

usual preparation the femoral artery was compressed against the pubic ramus and the rubber bandages applied as above. The saphenous vein was exposed by infiltration anæsthesia, the ligatures passed, and the cannula inserted as described above; and 50 c.c. of 0.5 per cent. novocain solution were injected. In ten minutes anæsthesia was complete.

Anteroposterior flaps were made at the junction of the middle and upper thirds of the thigh and the skin flaps dissected back without the least pain to the patient. The muscles were divided down to the bone and pushed back sufficiently to allow for a high division of the bone. Throughout this step the only complaint by the patient was that he felt electric shocks in his leg, and when the sciatic was cut a shock twisted his big toe. The bone was sawed without any pain to the patient. The remaining steps, completed in the ordinary manner, were painless.

Throughout the patient's pulse ranged from 72 to 80, and on his return to the ward he enjoyed his midday meal. The day after the operation his temperature rose to 101° and then fell to normal on the fourth day, where it has remained. On the fourteenth day after the operation he was up in a chair for the first time in 14 months. The wound healed without unusual reaction.

CASE II.—*Hallux Valgus.*—Woman; aged 44; was admitted to Bellevue Hospital (Dr. Woolsey's service) on January 20, 1909, complaining of pain over both great-toe joints. Both great-toe joints were swollen and reddened, the bursæ filled with fluid, and the toes abducted so that they rested across the other toes.

After the usual preparation the rubber bandage was rolled over the toes and foot to a point just above the ankle on the left side, and fastened there. A vein was exposed and about 30 c.c. of 0.25 per cent. cocaine solution injected. The solution could be readily seen entering the veins over the dorsum of the foot and anæsthesia was complete in one minute. The bursa was dissected out, a wedge-shaped piece of bone removed from behind the head of the first metatarsal, and the toe manipulated into position with absolutely no sensation on the part of the patient. Before closing the skin incision the veins were thoroughly flushed with warm salt solution and the tourniquet loosened as recommended by Bier. The wound was then closed, dressed, and the tourniquet removed. At the end of one hour the patient complained of severe pain in the foot, which she described as tingling or burning in character, as " if it had been

frost-bitten." Three hours after the operation the patient had a shaking chill and said she felt sick and nauseated, but was relieved by ⅛ grain of morphine hypodermically. Her temperature rose to 102.5° F. and then gradually fell to normal. The wound healed kindly except at one point, where the skin became a little blue and looked doubtful and a stitch was removed, after which it granulated in rapidly.

Her sole complaint throughout was that the rubber bandage at the ankle was too tight, a just complaint, as I believe we had wrapped it with too much earnestness in our zeal to render the foot bloodless.

CASE III.—*Tuberculous Tenosynovitis of the Extensor Tendon Sheath of the Arm.*—Man; 35 years of age. The process involved the extensor tendon sheath from the level of the ulnar styloid about six inches up the arm, and was filled with small movable bodies.

After freeing the forearm of blood by compressing the bracheal and elevating the arm, the rubber bandage was applied from below upwards and fastened just above the elbow. A large vein on the ulnar side of the arm which had been previously selected was exposed under cocaine infiltration, the cannula inserted and 50 c.c. of 0.5 per cent. and 50 c.c. of 0.25 per cent. novocain-salt solution injected. Anæsthesia was complete in 15 minutes and the man, a rather stolid individual, watched the skin incision, saying that he had no pain although he saw me cutting. The tendon sheath was opened and dissected out, the wound wiped with the iodine-glycerine solution of Durante, and the tissues loosely closed over the tendons. The veins were flushed in the usual manner, a few bleeding points caught and tied, and the skin closed with two small rubber-tissue drains at each angle. He had no constitutional reaction.

From my experience novocain is the ideal anæsthetic for this method. Cocaine in the one case in which it was used gave a marked constitutional reaction, and although its action was more rapid the likelihood of dangerous symptoms is so much greater that it has nothing to commend its use.

Its superiority to infiltration anæsthesia for the types to which it (intravenous) is adapted is most marked. It is simpler, more rapid, and more complete, and will supplant the slower method in many cases.

A MODIFICATION OF THE CRILE TRANSFUSION CANNULA.

BY BERTRAM M. BERNHEIM, M.D.,

OF BALTIMORE, MD.

From the Hunterian Laboratory of Experimental Medicine, The Johns Hopkins University.

THE instrument (Fig. 1) consists of a hollow tube 3 mm. long, having three rounded, sharp-pointed hooks on one end. These hooks are 2 mm. long, are placed at equidistant points around the lumen and flare outward just a bit at their tips. Between two of the hooks is the handle, which comes out in

FIG. 1.
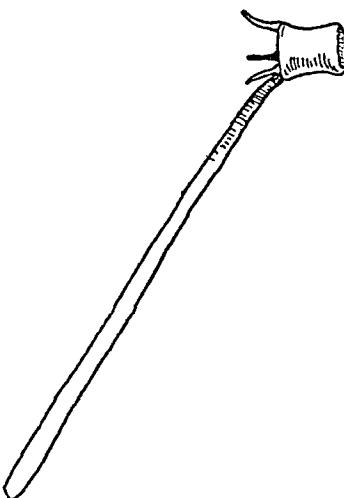
The three-pronged cannula.

the same direction as the hooks, but, in addition to being much thicker, the handle is 2½ cm. long and is flattened a little so as to be easily held. The cannulæ are made in four sizes, referring to the bore, 1½ mm., 1¾ mm., 2 mm., and 2¼ mm.

The technic [1] of the transfusion is in most respects similar to that used for the Crile cannula. The vein of the donee is carefully isolated and, after being tied off distally and secured proximally by a bull-dog clamp, is divided, leaving about 3 cm. free for manipulation. The lumen of the vessel is thoroughly

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[1] Crile: ANNALS OF SURGERY, September, 1907.

washed out with warm saline, followed by liquid vaseline, after which all superfluous adventitia is removed. The artery of the donor is prepared in a similar manner.

FIG. 2.
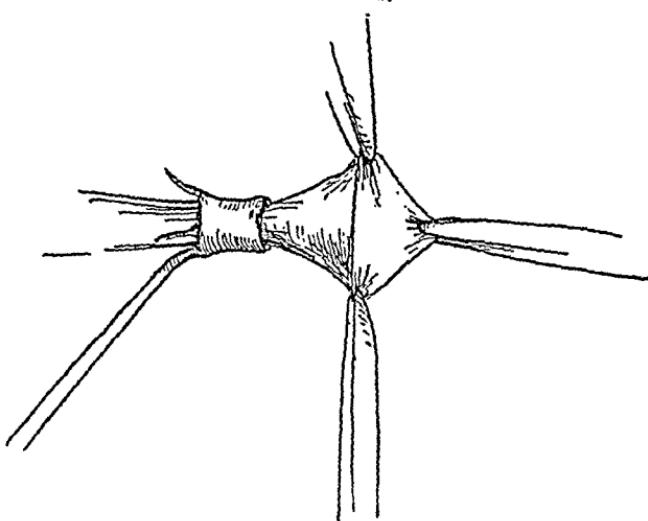
The vein drawn through the cannula and about to be everted over it.

The vein is then, by means of a needle and thread, passed through the cannula [2] (Fig. 2), hook end first, grasped by mosquito clamps at three equidistant points along its lumen, everted over the cannula and impaled on the three hooks

FIG. 3.
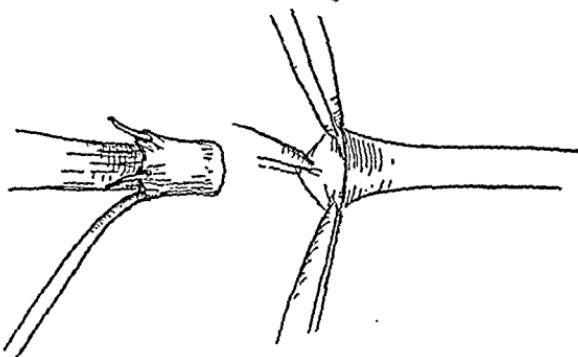
The vein passed through the cannula and everted over it, ready to receive the artery about to be drawn over it.

(Fig. 3). Next, the artery is seized in a similar manner by three mosquito clamps and, after being gently dilated, according to the suggestion of Crile, by the end of a clamp pre-

[2] The size of the cannula selected should be judged by the actual tissue thickness of the collapsed vein which is to be passed through it.

viously dipped in sterilized oil, is gently pulled over the
cannula with its everted vein and also impaled on the three
hooks. A tie is now placed around the cannula (Fig. 4), for
the sake of greater security, and the blood allowed to flow,
the clamp on the vein being removed before that on the artery
(Fig. 5).

FIG. 4.
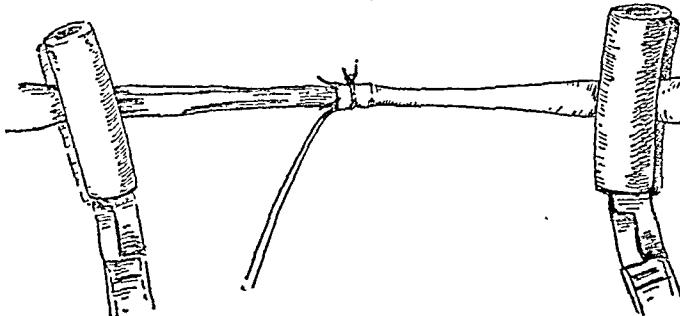
The communication between the artery and vein perfected; clamps still in place
compressing the respective vessels.

The advantage of this over the ordinary Crile cannula
is that it is absolutely unnecessary to hold either vessel while
the tie is being placed around the cannula. This difficulty,
slight as it may seem, is often a most serious drawback to

FIG. 5.
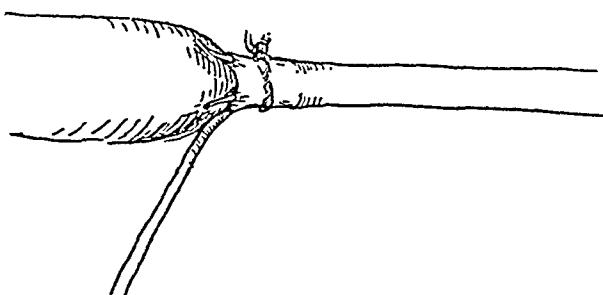
The artery and vein as finally secured together, and the flow of blood going on.

the successful performance of a transfusion.[3] As a matter
of fact, if the artery has not been too much dilated before
being impaled on the hooks of our cannula, no tie at all will
be necessary, as there will be enough pull on the artery and
vein to prevent leakage. As a routine, however, we think
it best to put one tie around the cannula and vessels.

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[3] Hepburn: ANNALS OF SURGERY, January, 1909.

THE "OPEN-SEAT" PELVIC BINDER.

A PRACTICAL BANDAGE FOR OPERATIONS ON THE SCROTUM AND TESTES AND
ILIO-INGUINAL REGION.

BY SAMUEL E. NEWMAN, M.D.,

OF ST. LOUIS, MO.

OPERATIONS about the scrotum and inguinal regions have
been greatly improved and the results are not comparable with
those of antecedent years. But it usually provokes strong com-
ment to see the bandage applied after an almost technically
perfect operation. To say the bandaging is crude, puts it
lightly; and I therefore do not think my paper needs an excuse.

No part of the body seems more difficult to bandage
properly than the scrotum, and probably none is so grateful
for small attentions. The scrotum should neither hang like
a bag nor be squeezed between the legs. Postoperative com-
fort is greatly augmented by supporting the part in a high
posture. If this position, which is much desired and seldom
obtained, can be secured there is less likelihood of venous
oozing and serous effusion into the sack; the tension on the
stitches is reduced to a minimum and primary union made
more certain. Sometimes it seems as if the success of the
surgical procedure is frustrated by the lack of proper support
and protection of the part.

The convenience which the "open-seat" offers to both
patient and nurse is of real importance, and no word of mine
is necessary to point out the desirability of this special feature.

Material.—The full width of unbleached muslin is used;
for the small size one and one-quarter yards, and for a large
size one and three-quarter yards are sufficient. Two sizes
will accommodate the usual run of cases. The material
shrinks after washing and it is best to use a shrunken muslin
for the bandage if it is to be laundered and re-applied. One

FIG. 1.
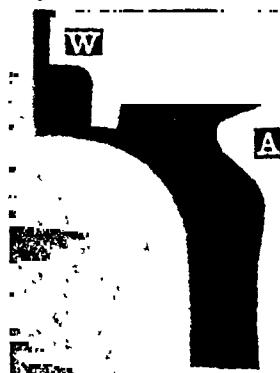
Cutting out the bandage. Fold the length of the material on itself, once. Cut the muslin as indicated at *W*. Open the doubled muslin and the resulting pattern should be Figure 1, a two-tailed binder cut out at *A* for the anal opening.

FIG. 2.
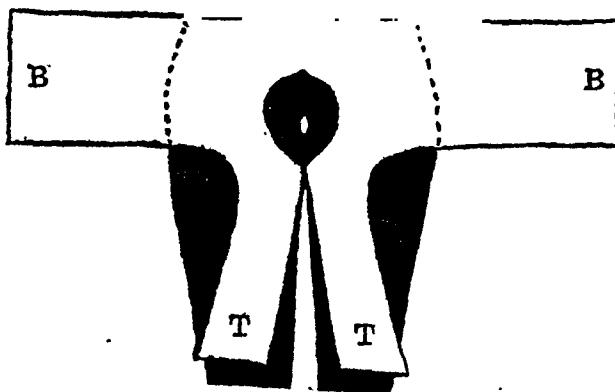
Applying the bandage, posterior view. The bandage is put in position so that the rectal opening is in the center of the bandage. The abdominal ends, *B, B,* are brought out to either side of the patient. The perineal tails, *T, T,* are under the thighs ready to be brought forward between the legs.

FIG. 3.
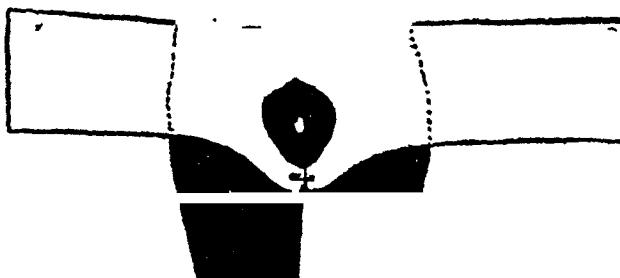
Posterior view. The two tails are brought forward between the legs and a safety-pin locks the two sides over the perineum.

Fig. 4.

Anterior view. From below upward the two tails are joined with a few safety-pins. A high opening is left for the penis. Very material assistance is gained if someone pulls on the tails while the pins are being inserted.

Fig. 5.
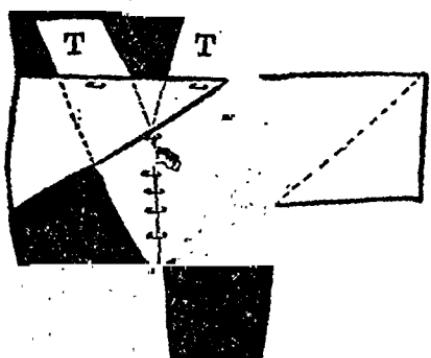
One side of the abdominal binder is folded into a triangle, brought across the abdomen, and fastened. The other side is treated in the same way and any excess of material, T, T, is turned under.

Fig. 6.
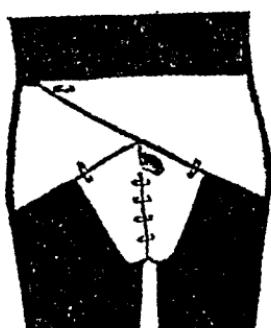
The completed bandage. From below, where the bandage is open, push in a good quantity of cotton to bolster up the scrotum. This raises the part to a high position and protects the wound from contamination.

thickness of the material may be enough, but the binder is stronger and more lasting if it is composed of two layers and the edges nicely stitched together.

ADVANTAGES.

1. The patient is not lifted; turning on the side is all that is required in applying the bandage.

2. It is held in place by the spines of the iliac bones and does not tend to slip.

3. The scrotum is not merely supported between the thighs but rests on the pubes.

4. Urination is not interfered with.

5. Easy access to the rectum; defecation does not necessitate a change of the bandage.

6. The bandage does not become stringy and see-saw the skin of the entire region.

7. Inspection of the wound is easy and requires little more than the removal of a few safety-pins.

8. After dressing the wound the same bandage may be re-applied; if the binder is soiled, it is laundered and re-used.

NOTE ON SILVER FOIL IN SURGERY.

BY JOSEPH S. LEWIS, M.D.,

Intern at the German Hospital in the City of New York.

It is a repetition, but surely not a vain one, to assert the value of silver foil as a surgical dressing. Its use has become firmly established in some hospitals while disregarded or unknown in others.

Following the work of Müller (1899) and Naegli (1893), to which he refers, Bolton[1] in 1894 demonstrated the inhibitive and bactericidal action of various metals. Halsted,[2] founding the practical use of silver foil on the laboratory work of Bolton, introduced it into the wards of the Johns Hopkins Hospital in 1895.[3] Since then the use of silver foil dressing has been propagated largely by such as have seen it used in Baltimore.

In 1896 Credé[4] published his observations on the mode of action of silver and its compounds, his work resulting in a flood of literature which carried numerous silver compounds into general use. On the compounds we have nothing to add.

Metallic silver as an aseptic dressing derives its value chiefly from its bacterio-inhibitive power, sufficient to check bacterial growth but not to alter the normal process of repair in the adjacent healthy tissues. The foil is therefore in harmony with the practice of asepsis in this sense, that it does not destroy living somatic cells. As demonstrated by Credé, the dressing lies in contact with a clean open wound without change, but in the presence of growing bacteria the lactate is formed, wherein the inhibitive power has been found to reside. The bactericidal power of the lactate in stronger solutions is markedly less than Credé was at first led to believe[5]; and this is doubtless fortunate, for were it bactericidal in the proportion 1 to 80,000, as first stated, it must, barring selective action, surely kill body-cell with bacterium.

In practice silver foil has been found to do no harm, thus fulfilling the first desideratum of all therapeutic measures. This is the general experience,[6, 7] as well as our own at the German Hospital. Our conclusions are based on its routine use during the past four months on upwards of 200 unselected cases with especial observations of about 100 of these. That it is harmless does, of course, not alter the fact that it is of little or no value on certain wounds, as, for instance, chronic granulating surfaces. It cannot reach bacteria growing in such granulations, and the sheets are prone to incorporate with the dried pus of profusely discharging wounds and rise from contact with the surface.

Of what use then is the foil? The following advantages have been demonstrated in the order stated:

1. On clean skin grafts the dressing is at its best and has replaced the older methods of wet dressings and gutta-percha, or the dry gauze dressings which present mechanical drawbacks. The unguents are either too active if antiseptic, or favor bacterial growth, or amount to occlusive macerating dressings like gutta-percha. Under the foil the grafted skin remains fairly dry, as is the condition of normal skin. One clean graft under silver was observed to have taken firmly on the third day after operation. Others were not inspected until the expiration of a week or more.

2. In plastic surgery where cosmetic results are desirable, the slight secretion along the linear wounds passes through the crevices in the foil to be absorbed by the superimposed gauze, minimizing scab formation. This was demonstrated in control dressings in which one half of a wound was covered with gauze and the other with silver.

3. In the usual clean wounds the possibility of infection from without is made more remote, especially in the groin, where the dressing may become wet with urine or slip and so expose the wound. In clean wounds near a discharging one, as in some secondary operations, the clean one may be protected against the other until union is established.

4. Though we have used it in only one such case and that

FIG. 1.
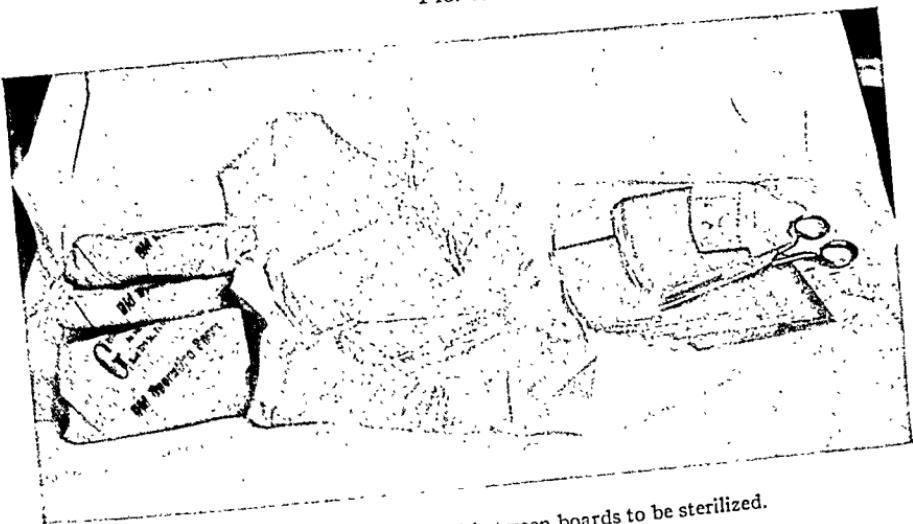
The cut leaves are placed between boards to be sterilized.

FIG. 2.
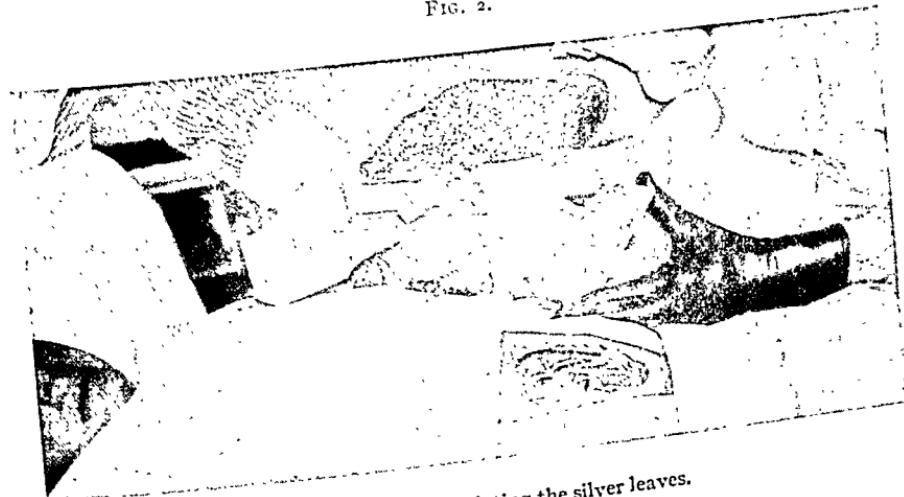
Manner of manipulating the silver leaves.

too recently to add the ultimate results, the foil may be recommended on theoretical grounds to prevent subdural adhesions, for which we refer to an article by Harris [8] for practical demonstration.

5. In clean rapidly granulating open wounds, the foil protects the delicate advancing margin of epithelium. Chronic ulcers such as the varicose type are not benefited. In two cases it was found suitable in burns after the acute stage was passed, but of no preference over other methods. In the acute or painful stage of burns it is useless.

Silver foil is no longer at a disadvantage as regards its cost, in that it may now be had for one-fifth the price quoted as reasonable by Hagner [6] in 1901. One dollar a month more than pays for all the foil that is used in this hospital.

The following method of preparation and use is essentially that of Halsted, save that we deviate from the use of paper over the foil, as favoring retention beneath the dressing of the slight postoperative bleeding or exudation of serum. The gauze is placed directly on the foil through the breaks or cracks of which the fluids find their way. Where the gauze adheres to a graft it may be removed by the usual methods, though if bleeding has been absolutely stopped this does not occur.

The leaves are cut and placed between non-resinous boards of one-half inch or greater dimensions, and put into packages with squares of sheeting (Fig. 1). At the hospital, sterilization is accomplished in the autoclave. For the office a cover of wrapping paper or old sheeting protects the packages, to be baked in the oven for 15 minutes or until the paper is slightly scorched.

In handling the foil for dressings, too great nicety means loss of time and temper. The papers, not the silver leaves, are seized with damp fingers while the silver, which for the moment adheres to the paper, is placed on the wound (Fig. 2).

We are convinced that silver foil should be a familiar surgical dressing in every well-regulated hospital.

REFERENCES.

[1] Bolton: The Effects of Various Metals on the Growth of Certain Bacteria, Trans. Assoc. Am. Phys., 1894., vol. ix.

[2] Halsted: Reference to Introduction of Silver Foil, Johns Hopkins Hospital Reports, vol. vii, p. 224.

[3] Bloodgood: Ibid., p. 371.

[4] Credé: Silber als Antisepticum in chirurgischer und bacteriologischer Beziehung, Arch. f. klin. Chir., vol. liii, 1906.

[5] Zajontschkowski: Bacteriologische Untersuchungen über die Silbergaze nach B. Credé, Centralblatt f. Chirurgie, vol. xxiv, 1907.

[6] Hagner: Metallic Silver as Suture and Dressing, Nat. Med. Rev., April, 1899.

[7] Gauthier: Sur l'emploi de fils d'argent cables pour les sutures et des feuille d'argent laminés pour les pansement, Assoc. Franc. de Chir., 15 Cong. de Chir., 1902.

[8] Harris: The Use of Silver Foil to Prevent Adhesions in Brain Surgery, Jour. Am. Med. Assoc., vol. xlii, 1904.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, May 12, 1909.

The President, Dr. Joseph A. Blake, in the Chair.

ENUCLEATION OF THE TONSILS.

Dr. Frank S. Mathews presented a number of children whose tonsils he had removed by the finger-enucleation method. In one of the cases the operation was done a year ago; in another, only a week ago.

The cases were shown in order to illustrate the fact that by this method surgeons are less likely to injure the wall of the pharynx than by the methods in which knives, scissors and dissectors are used and the normal architecture of the pharynx may be interfered with. After complete enucleation of the tonsil the wound healed as well and even better than after tonsillotomy, and cicatrization, the result of injuring the pillars and which was apt to draw the uvula to one side, was absent.

In addition to the patients, Dr. Mathews showed a number of tonsils that had been removed by this method.

URETERAL CALCULUS IN A CHILD: TRANSPERITONEAL AND RETROPERITONEAL REMOVAL.

Dr. John F. Erdman presented a child, 7 years old, who had been the subject of impacted calculus in the right ureter, directly over the spine of the ischium. The patient's symptoms dated back for three years, consisting chiefly of hæmaturia and pain simulating appendicitis. The child was X-rayed three different times, each picture showing a ring of shadow in the course of the right ureter over the spine of the ischium. The ureter was reached without much difficulty through a transperitoneal retroperitoneal incision, and the calculus was removed. The child's convalescence was uneventful, the wound healing in the course of two weeks.

NEPHRECTOMY FOR TUBERCULOSIS OF THE KIDNEY.

Dr. Benjamin T. Tilton presented a kidney, together with the person from whom it had been removed. The patient was a girl of 18 years, who up to a year and a half ago had been well with the exception of an attack of smallpox at the age of 6. There was no family history of tuberculosis or renal disease. Eighteen months ago she began to have pain in the right loin, accompanied by frequent and painful micturition. She never noted anything abnormal in the character of the urine. Three months later she was operated on at another hospital, an incision being made in the right loin, and pus evacuated. She remained in the hospital for three months and left with a discharging sinus. From that time up to February 2 last (about 16 months) she complained of nothing excepting the discharging sinus, for the relief of which she came to the hospital.

Examination at this time showed an anæmic but fairly well nourished young woman. Heart and lungs were negative. In the region of the right kidney a good-sized mass was easily made out by palpation, and was somewhat tender. Posteriorly, a sinus discharged a moderate amount of pus. The edges of the sinus were pale and flabby. The patient's temperature ranged from normal up to 100.8. The urine was clear; specific gravity, 1010; urea, 1.6 per cent. It contained no albumin, and microscopically a few epithelial cells.

Cystoscopic examination showed a healthy bladder, with no signs of cystitis. The right ureteral orifice was contracted, and no urine flowed from it. The left ureteral orifice was normal in appearance, and clear urine issued from it.

A diagnosis was made of tuberculosis of the right kidney, with occlusion of the right ureter, and a healthy left kidney. Nephrectomy was decided upon. Thinking that the first operation had been a nephrotomy, Dr. Tilton said he anticipated a great deal of difficulty in removing the kidney in the presence of dense adhesions to the surrounding structures. To his great surprise, upon cutting down upon the kidney, he found that it shelled out with the greatest ease, there being only the thinnest adhesions with the surroundings. This was accounted for by the fact that the kidney had not been opened at the first operation, but merely a perinephritic abscess incised and drained. The primary source of the abscess, namely, the tubercular kidney,

had been left intact, and therefore had not become the seat of secondary pyogenic infection with resulting adhesions to the surrounding parts.

The ureter was exposed for several inches, and tied separately from the vessels. Chromic gut was used for both ligatures. The patient reacted well from the operation, and made an excellent recovery. She had gained about ten pounds in weight since the operation, which was done a little over two months ago. The sinus had not entirely healed, but the discharge was very slight.

The specimen showed a caseous degeneration of the entire kidney, with liquefaction in some portions. There was found a minute communication between the interior of the organ and the sinus, which accounted for the persistent discharge from the fistula in the loin.

Dr. Tilton said the case demonstrated the possible origin of a perinephritic abscess from a tubercular kidney, and the incompleteness of the result of simple incision of such an abscess. Whether or not it was desirable in every case of perinephritic abscess to examine the kidney at the time of operation was probably a matter of individual judgment. If, however, there was a distinct history of renal symptoms, it would seem a wise course. In this particular instance such an examination would have led to the discovery of tubercular disease of that organ, and a nephrectomy would have saved the patient the discomfort of a sinus persisting for a year and a half.

DR. HOWARD LILIENTHAL, discussing Dr. Tilton's suggestion that in some cases of perinephritic abscess an examination of the kidney itself might reveal its tuberculous character and lead to an immediate nephrectomy, said that in many instances where the abscess was large and the kidney in bad condition such a procedure would cause tremendous shock. On the other hand, by drainage and delay, we were apt to get troublesome adhesions, and to obviate these difficulties the speaker said that in a number of cases he had resorted to a nephrectomy in two stages. He first opened the abscess and drained the kidney, if necessary, and then, five or six days later, removed the kidney. By that time the size of the organ would have diminished, the abscess cavity would be largely obliterated, and the completion of the operation would be comparatively safe and easy.

APPENDICITIS: A SERIES OF 105 CONSECUTIVE OPERA-
TIONS WITHOUT MORTALITY.

DR. CHARLES N. DOWD read a paper on this subject, and showed a number of patients illustrating the same. (See page 762.)

DR. LILIENTHAL said it was not often that we heard of 105 unselected consecutive cases of appendicitis without a death. Both Dr. Dowd and the patients were to be congratulated upon such an excellent showing. The speaker said he was heartily in favor of the method described by Dr. Dowd, and had practiced it himself. Its main feature was not to interfere any more with the peritoneum than was absolutely necessary, neglecting the presence of intraperitoneal fluid, even pus.

POPLITEAL ANEURISM: RECONSTRUCTIVE OPERATION.

DR. JOHN A. HARTWELL presented a man, 42 years old, who was admitted to Bellevue Hospital on February 11, 1909. His family history was unimportant, and he gave an indefinite history of syphilis. His occupation, which was that of a machinist, entailed hard work, but there was no history of his ever having injured his knee.

About six months ago he noticed a small swelling in the left popliteal space, which had gradually increased in size. It was the seat of a constant dull, aching pain. At times he had noticed that his leg was of a bluish color, but there had been no symptoms referable to nerve pressure.

Physical examination in general was normal, and there were no positive evidences of syphilis. In the left popliteal space there was a typical aneurismal swelling the size of an orange, which gave all the classical signs of that condition. It was apparently of the sacculated type. Pulsation was absent in the dorsalis pedis and posttibial arteries.

Operation, February 19, 1909, under gas and ether anæsthesia. A Martin bandage was applied from the foot to the upper third of the thigh, completely emptying the sac. An 8-inch incision was then made over the tumor and carried downward through the tissue to a false aneurism sac, with the vein and artery lying on its external, posterior aspect. The sac was then opened, freed of blood clots, and was found to communicate with

the arterial lumen by two openings lying on the anterior internal aspect of the artery. There were no blood clots in the inside of the artery, and the arterial wall, although somewhat dilated and thickened, seemed comparatively normal excepting at the sites of the rupture. The intima seemed normal. The two openings, one about an inch and a half, the other about half an inch in extent, were closed with fine silk, thoroughly vaselined, threaded on No. 16 needles. Two rows of sutures were applied in such a way as to closely approximate the intimas. The constricting bandage was then removed and the blood freely pulsated through the artery. It was then noted that the condition was a fusiform aneurism, and with the full force of the circulation the artery dilated in its centre to about one inch in diameter, the longitudinal extent of the dilatation gradually decreasing in either direction for about two inches. It was feared that a recurrence would take place if left in this way, so a further operation was undertaken. The artery was digitally compressed above the seat of the disease, the fusiform sac was split throughout its length, and a reconstructive operation was done, leaving a canal of normal size, the intimal surfaces being brought in contact by means of chromic gut sutures on a curved needle. The remainder of the sac was sutured down over this with chromic gut, three layers in all being used. On releasing the compression, blood circulated freely through the newly formed canal. The wound was sutured with a small drain in the false sac.

Circulation in the leg and foot was sufficiently good on the day following the operation, although no pulsation ever returned in the distal arteries. Four days after the operation there was evidence of a blood collection in the false sac, with a rise in temperature. The superficial wound was opened, and a collection of blood and serum evacuated which was just beginning to undergo suppuration. This was washed out and a drain inserted. An examination of the reconstructed artery showed pulsation as far down as the middle of the operative site; below this it was obstructed, with the evident formation of a clot. At the second dressing, two days later, this clot occluded the entire site of the arterial operation.

On March 20, the first time the patient was allowed out of bed, there was a sharp hemorrhage, which was controlled by a tourniquet, applied for half an hour, with subsequent firm pres-

sure over the popliteal space. The source of the bleeding was not determined. The subsequent history of the case was uneventful. The wound in the false sac granulated, leaving a moderate amount of contraction at the knee joint, which was gradually growing less.

The case was shown because of the interest attached to the failure of the reconstruction of the artery, although the result, so far as the circulation in the leg was concerned, was entirely satisfactory. It was not believed that the infection within the false sac was in any way the cause of the failure, because the artery itself was not in contact with the infection, and that part of the operative field showed no evidence of suppuration at any time. If an infection in the arterial wall was present, it was not sufficiently marked to show gross signs. Had the necessity for reopening the wound not arisen, so that direct inspection of the artery was possible, the case would undoubtedly have been accepted as one of success of the reconstructive operation,—for the functional result was good, and any subsequent absence of pulsation in the popliteal artery would have been explained by the formation of cicatricial tissue over and around it.

SECONDARY GASTRO-ENTEROSTOMY.

Dr. Hartwell presented a man of 34 who was admitted to Bellevue Hospital on April 9, 1909. His family history was unimportant. He was operated on at Bellevue Hospital in 1903 by Dr. George Woolsey for an acute exacerbation of recurrent appendicitis, and the appendix was removed. His recovery from that operation was uneventful. He was readmitted to the hospital, in Dr. Woolsey's service, on January 14, 1908, and gave the following history: For the preceding eight or nine months he had suffered from symptoms pointing to gastric ulcer, and he had been treated in the City Hospital for that condition. His chief symptoms were gastric pain and the vomiting of blood. On January 11 he was seized with persistent vomiting, and there was more or less abdominal pain, which was most severe in the region of the epigastrium.

Examination on admission gave the findings of a subacute perforation of a gastric ulcer, for which an immediate operation was done by Dr. Woolsey. Examination of the stomach showed some adhesions about the posterior wall in the lesser sac, which

was the apparent site of the ulceration. The pylorus was found to be patent, and the stomach was not materially dilated. No acute perforation was present, and, in the absence of pyloric stenosis, a gastro-enterostomy was deemed inadvisable. The adhesions on the posterior wall were not disturbed. The post-operative course was uneventful, and the patient was discharged on February 4, apparently in good health, and without gastric symptoms. He remained well until March, 1909, when there was a recurrence of the previous symptoms. For three weeks prior to his recent admission to Bellevue Hospital on April 9, he had been suffering almost continuously from colicky, cramp-like pains in the epigastrium, radiating under the costal margin to the right lumbar region, and occasionally to the left shoulder. He had vomited practically everything ingested during this time, but there had been no blood in the vomitus.

The patient had the facies of abdominal suffering and was moderately emaciated. Examination showed no abnormality excepting that due to the abdomen. Here, scars of the previous operation were seen, and palpation over the epigastric region, particularly just beneath the ensiform, caused marked pain. The stomach was apparently enlarged. No masses could be made out and there was an absence of abnormal rigidity.

Gastric analysis, one hour after a test meal, showed 250 c.c. of undigested food. Total acidity, 50 c.c.; free hydrochloric acid, 10 c.c.; loosely combined acid, 22 c.c. No lactic acid. During the week that he remained under observation in the ward he suffered constant pain, but on a very limited diet; there was no vomiting.

Operation: This showed the stomach to be dilated to at least twice its normal size, though the pylorus seemed to be patent. There was a marked absence of adhesions. On the anterior surface of the stomach, near the lesser curvature, and about an inch and a half from the pylorus, there was an indurated area, apparently the seat of an ulcer. On opening the lesser sac through the transverse mesocolon there was an absence of the adhesions described at the previous operation, and no evidence of ulceration existed. Posterior gastrojejunostomy was done by the no-loop method without reversal, sutures and clamps being used.

Since the operation, the patient has been entirely free from

pain, and there has been no vomiting excepting on the second day, when he vomited a small quantity of powdered milk curd, the first food ingested.

PRIMARY TUBERCULOSIS OF THE BREAST.

DR. HARTWELL presented a woman, 21 years old, who was admitted to Bellevue Hospital on February 19, 1909. Her family history was good, as was also her past history. There were no evidences of tubercular or venereal infection. She had never been pregnant.

About nine weeks prior to her admission to the hospital, the patient, on stooping, struck the lower outer quadrant of her left breast rather sharply against the corner of a table. Four weeks later, the breast, at the site of the injury, began to swell and show evidence of an inflammatory reaction, with the subsequent development of an abscess. One week ago this was incised, a small quantity of pus was evacuated and the cavity was drained.

Physical examination at the time of admission showed the patient to be a well-nourished young woman, above the average height, and of rather slight build. Aside from the condition of the left breast, examination showed nothing abnormal excepting scars on the inner aspect of the left arm and low in the axilla, the result of an old burn. The left breast was the seat of an inflammatory lesion involving the lower outer quadrant. There was a swelling, irregular in outline, lobulated, giving somewhat the feel of an adherent mass of glands, the skin over which was reddened and ulcerated in the centre, with a discharging sinus. The general appearance of the skin and sinus, with the granulation tissue underlying it, was that of tuberculosis. The involved portion of the breast was firm to palpation, and gradually shaded off into the normal breast tissue surrounding it. The diseased portion was somewhat tender to manipulation, and the axillary lymph-nodes were distinctly enlarged and tender.

The patient's temperature, on admission, was normal; pulse, 70. The leucocyte count was 16,000 with 74 per cent. polymorphonuclears. An incision made in the centre of the lesion prior to the resection evacuated a considerable quantity of tuberculous-looking pus. A small section of the tissue about the sinus was removed and submitted to Dr. Charles Norris, who pronounced it a tuberculous inflammation. The Von Pirquette and Calmette reactions were both negative.

Operation, March 26, 1909: This included a complete resection of the breast and axillary contents, the pectoral fascia being removed because it seemed to be involved in the process, but the muscles themselves were not disturbed.

The wound healed throughout the greater part of its extent primarily, although a small sinus persisted near the centre, which healed by granulation. About three weeks later a small collection of pus again formed at this site, and here a sinus still persisted. Material taken from this sinus on May 10 by curettage showed microscopically granulation tissue, without giant cells, and without definite evidence of tuberculosis. A second Von Pirquette done on May 10 gave a negative result.

The complete pathological report on the specimen removed was as follows:

The specimen consists of a breast and axillary contents. Just above the nipple is a circumscribed ulcer about 15 mm. in diameter, circular in outline, with sloughing base, which extends almost completely through the skin. Just to the outer side of the nipple is another ulcerated area about 15 mm. x 30 mm., of similar character, extending completely through the skin. On section of the breast tissue, there is a diffuse, pale, firm mass, invading the fat tissue, this lying immediately beneath the nipple and below it. Tissue of similar character is present immediately subjacent to the ulcers described. The lymph-nodes in the axilla are slightly enlarged and pale.

Microscopic Sections of the breast show slight hyperplasia of the glandular structure. The firm, white tissue described grossly is seen to consist of œdematous connective tissue between the fibrils, of which there is a considerable accumulation of lymphocytes in larger and smaller masses, and in places one sees definite circumscribed collections of epitheloid cells, the outer zone of which is bounded by lymphocytes; many of these contain large giant cells with their nuclei peripherally and radially situated. These tubercles are seen not only in the dense mass described, but in lymph spaces at some distance from the larger mass. Subjacent to the superficial ulcers are seen small clefts in the tissue lined by cells of similar character and distribution to those above just described.

Diagnosis: Tuberculosis of mammary gland.

The axillary lymph-nodes show evidence of chronic hyperplasia, without evidence of granuloma or tumor. No tubercle bacilli could be demonstrated in section of the breast stained for them. The spirochæta pallidum was also absent.

The case was presented because of the comparative rarity of tuberculosis of the breast as an apparent primary lesion. A most careful physical examination in this case fails to disclose any evidence of any other focus of the disease.

Dr. ALEXANDER B. JOHNSON said he wished to put on record a case of primary tuberculosis of the breast which came under his observation some years ago. The patient was a middle-aged woman with a tumor of the left breast which she said had existed for several years, but which had recently begun to increase rapidly in size. The appearance of the growth was that of a large carcinoma, involving almost the entire breast. The skin overlying it was reddened, and it suggested an extremely rapid type of malignant disease. The glands in the axilla were moderately enlarged. Upon removing the breast, together with the muscles and the axillary contents, it was found that the tumor was an ordinary fibro-adenoma; but the entire gland, including the nipple, was the seat of an acute miliary tuberculosis. The enlargement of the axillary lymph-nodes was due to a simple inflammation. The woman made a perfectly good recovery.

OPERATIVE TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR.

Dr. ROYAL WHITMAN presented six cases illustrating operative methods in the treatment of fracture of the neck of the femur for the purpose of restoring the function of the injured part. The first patient was a girl 16 years of age, who two and a half years ago was brought to the Hospital for Ruptured and Crippled for the treatment of what was supposed to be hip disease. A diagnosis of epiphyseal fracture of the neck of the femur was made and the joint was opened by the anterior incision, exposing the extremity of the neck which, as in all cases of this type, was displaced upward and forward, lying in front of the head of the femur. A thin section was removed sufficient to permit the insertion of a chisel between it and its head, and by prying and rotation of the limb the displaced parts were brought into perfect apposition. The patient, who at the time of the operation was completely disabled, is now presented as a perfect functional cure.

The second patient shown was a girl 15 years of age who had been admitted to the hospital in December, 1907, for hip disease. The limb was flexed, rotated outward, and there was pain and muscular spasm on attempted motion. There was no history of injury. The joint was opened and the displacement was identical

with that of the last case, as was the treatment. The result also was perfect functional recovery.

The third patient was a young man 19 years of age, who fourteen months before he had come under observation had fallen on the ice, the injury causing apparently an incomplete epiphyseal separation. He continued to limp about for a year or more when another fall completed the fracture and caused practical disability. The same operation was performed as in the other cases, but the replacement of the fragments was somewhat more difficult owing to the delay. The result is very satisfactory. There is but slight limp, a fair and increasing range of motion. The patient suffers no discomfort and is at work as the driver of a truck.

The fourth patient, a boy 16 years of age, differed from the others in that he was of the large, fat, overgrown type in which there was evident predisposition to deformity. The fracture had been induced by a slight injury. The operation was performed about six months after the injury; the method and the result differed in no essential from those of the preceding case.

The fifth patient, an amateur acrobat 18 years of age, about two years ago had fallen a distance of thirty feet. He was taken to a hospital where he received the accepted treatment for an impacted fracture of the neck of the femur. Two months later he was discharged with the advice that the limb be used; but as there had been no improvement he came to the Hospital for Ruptured and Crippled, where he was admitted for the treatment of ununited fracture of the neck of the femur. Upon opening the joint it was found that the neck of the femur had been in great part absorbed by the friction induced by motion and pressure. Its extremity was freshened, brought into apposition with the head and fixed by a drill passed through the trochanter. Firm union resulted. There is now free and painless motion but slight limp, and function is steadily improving.

This case illustrates the fact that inefficient treatment, even in a most favorable case, may be followed by the same unfavorable result as when applied to the adult type of injury.

The last patient was a boy 12 years of age, who two years ago fell from a car, fracturing the neck of the femur. He received no treatment and union followed with deformity of the coxa vara type. He was admitted to the hospital last year because of

limp, pain and distortion of the limb—symptoms directly dependent upon the depression of the femoral neck. The indication was therefore to restore the normal angle, and this was accomplished by the removal of a wedge of bone from the base of the trochanter, sufficient to permit full abduction of the thigh. The result is perfect functional recovery.

ENDOTHELIOMA OF THE CAROTID BODY.

DR. HOWARD LILIENTHAL presented a woman, 56 years old, who gave a history of having had a small lump on the left side of the neck for the past thirty years. For the past five years this had become considerably larger, especially during the past year, when she became alarmed and wished to have it removed. The diagnosis of tumor of the carotid body was made before the operation, which was done about a month ago.

Upon exposing the growth, it was found that it involved the vessels to such a degree that it became necessary, as a preliminary step, to ligate and sever the internal jugular and common carotid quite close to the clavicle. The incision extended from below the ear, forward to the midsternal region, and then backward along the clavicle. The dissection was an extremely difficult one, lasting over an hour. The left pneumogastric nerve rested on the posterior surface of the tumor and was peeled off, as the speaker said he did not want to run the risk of causing the sudden death of the patient by resecting it.

On the day after the operation the patient was completely aphasic and had a well-marked hemiplegia. The left eyeball was soft, with contraction of the pupil. The aphasia and the paralysis of the hand due to the cerebral anæmia rapidly disappeared, but the pupil of the left eye was still smaller than that of the right. The ocular symptoms were due to injury of the superior cervical sympathetic ganglion.

In discussing the prognosis of this case, Dr. Lilienthal said he had not the slightest doubt that there would be a local relapse. He recalled a similar case which was inoperable, where the patient finally became cachectic and died of general weakness, but without metastases.

DR. JOHN F. ERDMANN said that about ten years ago he operated on a case in which he excised about half an inch of the left pneumogastric nerve without any resulting bad effect.

VOLKMANN'S ISCHÆMIC PARALYSIS.

DR. HOWARD LILIENTHAL presented a boy of 12 years who in September, 1908, fell while walking in the street, breaking both bones of the right forearm. The double fracture was treated by an anterior and posterior splint. Subsequently, he developed a marked case of Volkmann's ischæmic paralysis, for which he was operated on by Dr. Lilienthal on January 18, 1909, four months after the accident.

An incision was made over the radius and ulna, removing about an inch of bone from each, and then introducing intra-medullary aluminum splints, as devised by Dr. Charles A. Elsberg, and the hand was put up in the position of extreme extension. Primary union with good position of the hand followed the operation, but gradually the arm again became somewhat con-tractured. The elbow was now perfectly straight, and the boy had good use of the hand, thanks to the untiring efforts of the patient's mother who practised daily massage and passive motion.

DR. WHITMAN said he would advise in all cases of this char-acter, before resorting to resection of the bone, the gradual cor-rection of the deformity by splints, after the method of Jones. It was a treatment, however, that required a persistent attention for many months, without which it would always fail.

DR. ALFRED S. TAYLOR said that a little over a year ago he presented a case in which he had done the same operation as that described by Dr. Lilienthal, and, as in this case, there was a recurrence of the deformity. That recurrence took place in spite of vigorous and faithful massage by a professional masseur. The trouble in his case, Dr. Taylor thought, was due to the fact that the muscles were cicatrized, and the bones, after having been resected, continued to grow. He saw no good reason for shorten-ing the bones nor lengthening the tendons, because both of these steps were unnecessary if there was sufficient muscle tissue. According to the literature, the method advocated by Jones had given many good results. There was another method which he had resorted to in cases of strong contracture of the muscles, and in one instance where there was marked posterior deformity of the wrist. Within four months, by the method described by a French writer named Martin, the hand could be brought into a position of extreme flexion. The method consisted, essentially, of building a steel framework over the forearm, and applying

elastic traction to the contractured muscles. This method was much more effective than any plan of rigid extension, such as was advocated by Jones.

Another important factor in the treatment of Volkmann's ischæmic paralysis, Dr. Taylor said, was to pay particular attention to the condition of the nerves. They should be released at the earliest possible moment from cicatricial pressure, so as to hasten regeneration.

DR. LILIENTHAL, in closing, said that while in certain cases he might be induced to try massage and passive extension without operation, he was convinced that any apparatus that was put on an arm of this kind had to be watched with the greatest care,— otherwise, ulceration was apt to result, as in these patients there seemed to be an inherent tendency to traumatism of the soft parts. As to the danger of non-union after resection of the bones, that possibility could be avoided by the use of the intramedullary splints.

MULTIPLE LIVER ABSCESSES.

DR. LILIENTHAL presented a man, 43 years old, who was admitted to the hospital on March 23, 1909, with the history of having had three attacks of gall-stone colic, the last one being accompanied by slight jaundice and fever.

Examination showed marked tenderness and rigidity in the right hypochondrium. The blood count showed 15,200 white cells, with 95 per cent. polymorphonuclears. On March 26 the abdomen was opened through the right rectus muscle, exposing the gall-bladder. The entire surface of the liver, particularly the left lobe, was studded with small abscesses, and by palpation one could make out crater-like depressions in various parts of the liver. A number of these abscesses were incised, evacuating considerable pus. The gall-bladder was then opened and drained, after removing a number of calculi. The patient made an uneventful recovery, with the exception of a gall-bladder sinus. which still persisted. A culture from one of the abscesses showed a bacillus coli infection.

This case was shown, Dr. Lilienthal said, on account of the extreme rarity of this condition. It was the second case he knew of where recovery took place after multiple miliary abscesses of the liver had been actually demonstrated at operation.

INTESTINAL RESECTION FOR STRANGULATED HERNIA.

DR. LILIENTHAL presented a man of 30, who on March 28, 1909, developed acute intra-abdominal symptoms which his physician recognized as being due to a strangulated left inguinal hernia, and advised him to go to the hospital at once. The man refused to go until the next day, and when Dr. Lilienthal saw him that morning the patient was in a condition of extreme shock as the result of a very aggravated form of strangulation, with œdema and ecchymosis involving the abdomen, scrotum and penis.

An immediate operation was done, disclosing a mass of blackened intestine which had entirely lost its lustre, and which involved at least four feet of what was apparently the ileum. The mesentery was thrombosed, with an entire absence of pulsation. It was incised in several places without resulting blood flow. A rapid resection of the gut was made by the method which Dr. Lilienthal had described at a meeting of the society several months ago. The segment that was to be resected was first tied off, then cut, the cut ends carbolized, and a side-to-side anastomosis made. The patient made an excellent recovery. The ends of the sutures used in tying off the gut were left hanging out of the wound, and came away on the fourteenth day. There was never any leakage of intestinal contents. By actual measurement, four feet of gangrenous intestine was resected.

Dr. Lilienthal said he showed this case with the object of again emphasizing the ease and rapidity with which this method of intestinal resection could be completed. In this case the patient's condition was such that any prolonged method would probably have proven fatal. In reply to a question, the speaker said he regarded the side-to-side anastomosis much quicker than the end-to-end, and in cases demanding great haste it was infinitely safer.

INJURIES OF THE KIDNEY.

DR. ALEXANDER B. JOHNSON read a paper with the above title, for which see page 715.

DR. LILIENTHAL said that one thing that struck him in listening to Dr. Johnson's paper was the enormous disparity between the number of cases of injury to the kidney in the male as compared to the female, and this difference was hardly explained satisfactorily by the reason given by the reader of the paper. It

was perhaps due to the fact that cases of movable kidney were much more frequently met with in the female than in the male, in children as well as in adults, and a freely movable organ was much more likely to escape injury than one that was firmly fixed.

DR. ELLSWORTH ELIOT, JR., briefly reported a case of posterior shot wound where the bullet, after perforating the gall-bladder, grazed the hepatic flexure of the colon and then passed through the right kidney and a part of the pedicle. The injury produced an extensive extravasation of blood. The gall-bladder and the injured kidney were removed, and the subsequent convalescence of the patient was interrupted by a perinephritic suppuration which was relieved by a counter-opening through the loin.

DR. BENJAMIN T. TILTON reported a case of kidney injury, giving rise to symptoms similar to those of an acute peritonitis. The patient was a boy of 10 years who was run over. He was severely shocked, and about the seventh day showed signs of peritonitis, viz., abdominal rigidity and tenderness, a high temperature, and vomiting. A median incision was made, which disclosed some free serous exudate in the peritoneal cavity. A second incision was then made over the kidney, opening a urinary abscess originating from a ruptured kidney. The abscess was drained, the peritoneal symptoms subsided, and the boy made a good recovery.

CORRESPONDENCE.

"TOTAL EXCISION OF THE SCAPULA FOR SARCOMA."

EDITOR ANNALS OF SURGERY:

In the ANNALS OF SURGERY for July, 1909, Dr. de Nancrède publishes an exceedingly interesting article giving the end results after total excision of the scapula for sarcoma. He has succeeded in collecting 65 cases in which the scapula alone was excised, and 9 in which more than the scapula was removed, 25 of these cases being tabulated by him for the first time.

Dr. de Nancrède's conclusions are certainly very pessimistic, but no more so than the statistics would seem to warrant, while between the lines one can probably read a doubt as to the correctness of the diagnosis in the few cases in which death did not ultimately follow from recurrence. It is probable that quite a number of other cases could be reported, but it is hardly likely that any of the successful ones have failed to be recorded.

While it is doubtless true that the prognosis in these cases is almost absolutely hopeless as to end results, nevertheless the operation itself presents no technical difficulties. Its immediate mortality should be almost *nil*, and the patient will have at least a few months of comfort and of hope, while there is always a bare possibility of even a permanent cure.

The two cases which I report only strengthen the contention of Dr. de Nancrède.

CASE I.—Mr. F. K., aged 56; farmer; Grove City, O. November 26, 1901. Physician, Dr. William Hoover. First noticed pain and stiffness in right shoulder about a year before. This had at first been regarded as rheumatic, but a growth manifested itself in three or four months. Had lost 15 pounds in weight. Pain quite severe. On personal examination the tumor was found to be nearly the size of the fist, and to have involved in its growth the joint and probably the upper end of the humerus. The axillary glands were also involved.

At the operation the entire clavicle and scapula were removed, together with the arm, and thorough cleaning out of the axilla. The growth was pronounced an osteosarcoma. Patient went through the operation nicely, and went home in fine shape. There was no recurrence at the point of operation, but the right lung became involved, and he died March 23, 1902.

CASE II.—Mrs. J. M. K., aged 39; West Leipsic, O. Physician, Dr. C. E. Beardsley, Ottawa, O. September 8, 1904. The patient was mother of four children. Eighteen months before had fallen in such a way as to strike the point of the right shoulder. No bruise was noticed at the time, but some soreness had persisted and had been attributed to rheumatism. A lump had been noticed two weeks before. Pain was of a dull character. Motion of the arm somewhat limited. Patient was an exceedingly well-nourished woman, the picture of health. The tumor involved the right scapula, was smooth in outline, and somewhat elastic. Did not extend above the spine. Skin not involved. The tumor seemed to be about two inches thick. (A brother of the patient had died of osteosarcoma.)

At the operation the entire scapula was removed, the operation being attended with no special difficulties. The disease seemed to be limited to the body of the bone, though both anterior and posterior surfaces were involved. The spine and other bony processes seemed to be free from disease. No involvement whatever of the clavicle, humerus, or the joint.

Patient made a rapid convalescence and returned home in fine condition, and with very satisfactory use of the arm. She remained free from any evidence of return until the following February; then there was a gradual development of a general sarcomatosis, and she died October 5, 1905.

The extent of the tissue involved in the first case led necessarily to a very unfavorable prognosis, and the recurrence was so prompt as to render it perhaps questionable as to whether anything was gained by the operation. At the time of the operation, however, every motion of the arm was attended with great distress, and this was entirely relieved by the surgical intervention. In the second case there was a clear gain of several months of good health, and I think life was unquestionably prolonged by the operation.

JAMES F. BALDWIN, M.D.

COLUMBUS, OHIO.

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LISTERINE

ANTIPYRETIC, ANALGESIC, AND ANTISEPTIC POWER

In speaking of the treatment of articular rheumatism, Hobart A. Hare, M.D., Professor of Therapeutics in the Jefferson Medical College and editor of *The Therapeutic Gazette*, says: "Any substance possessing strong antipyretic power must be of value under such circumstances." He further notes that the analgesic power of the coal-tar products "must exert a powerful influence for good." The lowering of the fever, no doubt, quiets the system and removes the delirium which accompanies the hyperpyrexia, while freedom from pain saves an immense amount of wear, and places the patient in a better condition for recovery. The researches of Guttmann show conclusively that these products possess a direct antirheumatic influence, and among those remedies, antikamnia stands pre-eminent as an analgesic and antipyretic. Hare, in his *Practical Therapeutics*, says: "Salol renders the intestinal canal antiseptic," a condition absolutely essential in the treatment of rheumatism. In short, the value of salol in rheumatic conditions is so well understood and appreciated that further comment is unnecessary. The statements of Professors Hare and Guttmann are so well known and to the point and have been verified so often, that the uses of "Antikamnia & Salol Tablets" are at once apparent. Each of these tablets contains two and one-half grains of antikamnia and two and one-half grains of salol. The proper proportion of the ingredients is evidenced by the popularity of the tablets in all rheumatic conditions.

ON THE LIMITED

The merciless heat made the passengers gasp as the Limited plowed its way steadily across the Western plains. Dreary, monotonous, was the vista of sand and scrub which greeted the eyes of the wearied travellers. To add to their discomfort, above the muffled roar of the train arose the continuous wailing of a child. More than one man cursed softly and sought refuge in another car—all, as it happened, crowded. Finally a harsh-looking passenger spoke.

"Why don't you keep that brat quiet?" he snapped.

The mother, a forlorn-looking woman clad in rusty black, looked pathetically up at him. "I've been trying to," she faltered. "But, you see, the heat and the long journey——"

A new expression stole over the harsh-looking passenger's face. "Give it to me," he said in a tone of marvellous gentleness; and the poor mother placed the fretful baby in his arms.

Whereupon he threw the child out of the window.

Sold again! —*October Lippincott's.*

THE GASTRIC NEUROSES

In all functional derangements of the nervous mechanism of the stomach, Gray's Glycerine Tonic Comp. will be found of extraordinary therapeutic value. Its action is manifold, manifested by an immediate influence on the gastric tissues and a substantial promotion of the general nutrition. As the secretory and motor functions are improved, the patient's whole condition is correspondingly benefited.

GLYCO-THYMOLINE IN OBSTETRICS

BY H. PLYMPTON, M.D., BROOKLYN, N. Y.

Just a word of suggestion to obstetricians regarding the offensive odor accompanying the lochial discharge after confinement, of which patients so frequently complain, and which no permissible amount of douching removes or eliminates.

Three ounces of Glyco-Thymoline in one quart of water, used as a douche, once a day, will absolutely remove the odor and wonderfully increase the comfort of the patient.

No tingling nor smarting sensation follows its use, and it is as efficient an antiseptic as any, without the objectionable features of nearly all others.

I have used it in many cases, and would as soon think of attending a case minus my satchel of necessaries as to go without Glyco-Thymoline.

GOOD AT FRACTIONS

The teacher was giving her class their first lesson in fractions. An object lesson seemed to be desirable.

"Mary McCauley," she said, "if there was a mince pie on your dinner-table, and your mother asked you if you would have a third or a fourth, what would you say?"

"A fourth," said Mary.

Some of the children tittered, and the teacher asked, "Why would you have a fourth?"

"'Cause," said Mary, "I don't like mince pie."

—*October Lippincott's.*

LYSOL

Lysol, the best-known disinfectant, germicide, and antiseptic, for use in surgery, gynecology, obstetrics, and general practice, is now used daily in nearly every hospital in the United States, including the Army, Navy, and Public Health and Marine Hospital Service.

Lysol is more efficient than either bichloride or carbolic acid: first, because it is non-poisonous; second, because it does not affect the skin; third, it does not coagulate albumen and allow the germ to live inside its hardened capsule; fourth, the bactericidal action of Lysol is five times stronger than that of carbolic acid.

The surgeon, gynecologist, obstetrician, and general practitioner have in Lysol an ideal antiseptic, disinfectant, and germicide for all uses, for it is stronger, safer, and cheaper than other chemicals used for similar purposes.

Modern text-books uniformly recommend Lysol as an established disease-preventing adjunct.

Current medical literature universally mentions Lysol in its clinical reports of major and minor operative procedures for the aseptic rendition of instruments, removing from the operator's hands all contamination or infective media, and disinfecting and deodorizing contagious and offensive pathological conditions.

The list of hospitals, clinics, and dispensaries using Lysol has so grown that it is practically a directory of the best institutions of the kind in the world.

EXCUSABLE

School children in Greater New York were required some time since to bring to their teachers vaccination and birth certificates. Frequent forgetfulness made one teacher impatient, and word went out that the certificates *must* be there on a certain morning. On that day an anxious little girl raised her hand the moment school opened, and, on being told to speak, said tremblingly:

"Please, teacher, don't get mad at me. I've forgot my excuse for being born."

—*October Lippincott's.*

IN PRICE, NOT SIZE

He looked in a store window, and saw, "Hats reduced." "Heavens!" said he to himself. "What was their original size?"

—*October Lippincott's.*

THE SENATOR CONFESSES

As every lawyer knows, Senator Daniel is the author of a comprehensive treatise on negotiable instruments, which is generally considered to be the leading authority on the subject. A friend one day inquired how it was that in the midst of his arduous political duties, which must have demanded his constant attention, he found the time to write two such exhaustive volumes.

"Well," replied the Senator, "it happened this way: A young fellow I knew came up to me one day and said, 'Say, Mr. Daniel, does a sight draft bear interest?' And—would you believe it?—I could n't answer that simple question. So I determined then and there to find out all about it. It took me a long time, but I did it."

"Well, Senator," observed the friend after a short pause, "*does* a sight draft bear interest?"

There was a moment's silence.

"Hanged if I know!" was the abrupt reply.   —*October Lippincott's.*

GOOD AT FRACTIONS

The teacher was giving her class their first lesson in fractions. An object lesson seemed to be desirable.

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"Cause," said Mary, "I don't like mince pie."   —*October Lippincott's.*

INAPPROPRIATE

The captain was explaining what would be done in case of accident.

"And should the ship strike a rock," he continued, "we'd burn red fire and send up rockets."

"But would n't that be a rather unusual time to celebrate, captain?" asked the tow-headed youth with the bull-dog pipe.

—*October Lippincott's.*

WHY?

Why is it that people sit t—h—i—s w—a—y
    In the car we miss,
And in the car we finally catch
    Are crowdedlikethis?

—*October Lippincott's.*

Forthcoming Books

Earle

Diseases of the Anus, Rectum, and Sigmoid

By SAMUEL T. EARLE, M.D.

Professor Emeritus of Diseases of the Rectum in the Baltimore Medical College; Surgeon in Charge of Rectal Diseases at St. Joseph's Hospital, the Hebrew Hospital, and the Hospital for Women.

Octavo. 400 pages. 150 illustrations. Cloth, $5.00.

THIS work was written to especially meet the requirements of the general practitioner and the medical student; great pains have been taken to make the text as brief as is consistent with a clear and comprehensive description of the subject-matter. The author has illustrated the text by plates (about one hundred and fifty) wherever he thought it would add to a clearer understanding of the subject treated.

Special pains have been taken to eliminate descriptions of operations that are now obsolete, and the author has limited himself to a description of those operations that are now in general use, or, if only recently introduced, have been found acceptable and advantageous by those thoroughly competent to judge.

Cases have not been cited except those of unusual importance and rarity, and the illustrations supply the place of the text wherever they answer the same purpose and save time to the reader; as in the chapter on malformations of the rectum.

The chapter on constipation is especially comprehensive, covering entirely the etiological field and at the same time being very concise.

The author has recommended the most modern methods for the diagnosis of special forms of disease, as in different varieties of ulceration, and has given full descriptions of certain forms of ulcerations of the rectum, not before described in any text-book on "Diseases of the Rectum," viz.: Ulceration of the Rectum due to Infection by Schistosoma Hæmatobium, Actinomycosis, and Gangrene of the Rectum.

All this has been done with special reference of saving time to the busy general practitioner and student, who need only the salient points of the information they seek.

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ANNALS OF SURGERY

ORIGINAL MEMOIRS.

A STUDY OF BURNS INVOLVING THE PERIOSTEUM OF THE VAULT OF THE SKULL.

BY J. M. MASON, M.D.,

AND

B. S. LESTER, M.D.,

OF BIRMINGHAM, ALABAMA.

WE have recently had the opportunity of treating, at the same time, two cases of extensive burns of the vault of the skull, destroying the periosteum over large areas of the parietal, occipital and frontal bones.

Both cases were treated on the expectant plan; that is to say, the burns were treated antiseptically and we waited for the denuded bone plates to be cast off.

In one case this occurred without accident or complication, and final healing resulted. In the other, the patient progressed satisfactorily for a month, when he suddenly developed hemiplegia, aphasia, and coma, and died from a large brain abscess.

A consideration of these cases, with autopsy notes on the fatal case, and examination of the exfoliated occipital and frontal bones from the other case, teaches us the pathological process which will result from destruction of the periosteal covering of the cranium.

CASE I.—T. R., black male, aged about 25, was admitted to

St. Vincent's Hospital August 22, 1907, suffering from electric burns of right hand and forearm, requiring amputation, several slighter burns about the face and body and a burn over the left parietal bone extending down to the periosteum.

After amputation of the forearm, the burns were dressed antiseptically. In a few days the burn on the skull had cleaned off, leaving the parietal bone exposed over an area of about three inches, the centre of which was near the parietal eminence.

While his other wounds were in process of healing, the patient had a little fever, after which his temperature remained under 99, and his general condition was good, until September 19, when he had a sudden rise of temperature accompanied by hemiplegia, and quickly followed by stupor and death on September 23, 1907.

An autopsy was secured, with the following findings: The outer table of the parietal bone was necrosed over the area of the original burn, but was not detached from the surrounding bone. The inner table under the centre of the burn of the outer table showed a circular area of osteitis concentric with the outer table but less than half the diameter of the outer dead layer. This had not separated from the healthy bone around it.

Opposite the centre of this circle, where it was in contact with the dura, there appeared upon the dura a circular suppurating spot about the size of a five-cent piece. On the under surface of the dura opposite the centre of this spot was a very much smaller suppurating focus, and where this came in contact with the brain was a minute point showing where the infection reached the surface of the brain. Immediately beneath this, in the tissues of the brain, was located an enormous abscess, destroying a large part of the left hemisphere (Fig. 1).

The necrosis and infection had traveled downward and inward toward a point corresponding to the centre of the original circular burn of the parietal bone, each layer of tissue showing an area of infection and necrosis smaller than the one above it, until, at the point of contact with the brain, only a minute spot of infection was apparent. As soon, however, as the brain tissue was invaded, the infection traveled with great rapidity, quickly destroying nearly half the cerebrum.

CASE II.—T. S., colored male, aged about 25, was admitted to St. Vincent's Hospital, September 8, 1907, suffering from an electric burn three inches in diameter over the middle of the frontal bone, and another several inches long extending from the

Fig. 1.
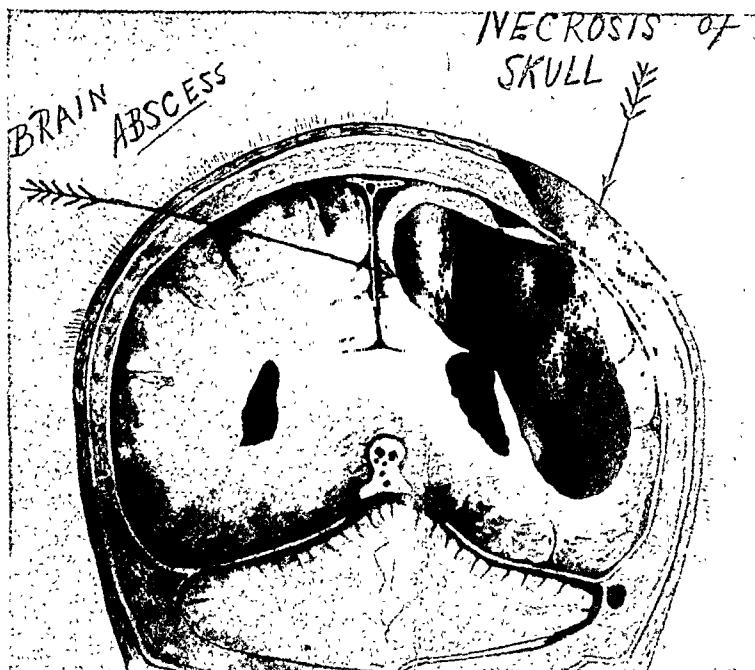
CASE I.—Cross section of head (diagrammatic), showing mode of infection of brain from necrosis of skull.

FIG. 2.

CASE II.—Occipital sequestrum. Inner surface.
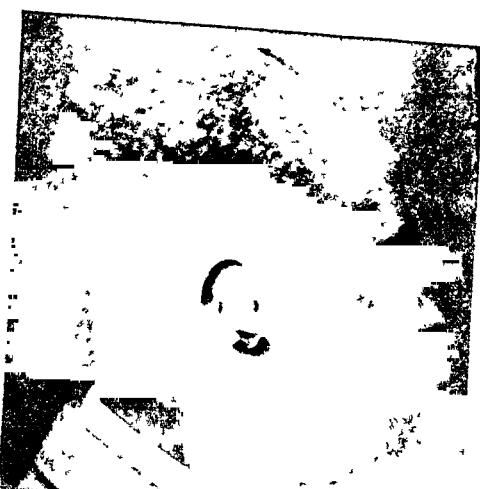

FIG. 3.

Outer surface.

FIG 4.

CASE II.—Frontal sequestrum. Inner surface

FIG. 5.

Outer surface.

FIG. 6.

CASE II.—Frontal cicatrix.

FIG. 7.

CASE II.—Occipital cicatrix.

upper part of the occipital bone well down on the neck. Both these burns charred the tissues down to the bones of the skull. There was also a third degree burn, several inches in diameter, over the left side of the chest.

The injuries were dressed antiseptically, and in a few days the burns on the head had cleaned off to the skull. The other burns were treated antiseptically until they had granulated sufficiently, when they were successfully grafted by Dr. Lester. We decided to pursue a waiting policy in dealing with the burns of the periosteum. While awaiting for separation of the sequestra, the rims of scalp around the borders of the burns were successfully grafted.

There was no tenderness under the area of exposed bone, and the patient ran a normal temperature. He remained in the hospital until October 31, and came back for dressings twice a week until December 20. We then lost sight of him until January 7, 1908, when we found the exposed bones loosened sufficiently to be lifted off (Figs. 2, 3, 4 and 5).

Near the centre of each exfoliated plate, the sequestration extended down through the internal table, and on removing the bone, the dura under these places was left bare.

The inner table was intact except for these central exfoliations.

These wounds were now dressed until the granulations were clean, and were then successfully grafted on January 22, 1908.

The head now presents a large cicatrix over the frontal bone and a similar one over the occipital bone. The brain is protected by the dura and by the inner table of the skull except near the centre of each cicatrix, where there is no bony layer. These layers are not much larger than half an inch in diameter, however, and are of no more seriousness than the opening left by a trephine of this size (Figs. 6 and 7).

The flat bones which form the vault of the skull are richly supplied with arterial blood through vessels which enter the outer table through the periosteum, and which enter the inner table through the endosteal layer of the dura. Larger nutrient arteries also enter the bones at different points.

The diploë lies between the outer and inner tables, and the interspaces are filled with channels for venous blood which finally leave the skull through various foramina at the base.

Anatomists differ concerning the presence of lymphatics in the dura or in the brain, so it is uncertain whether infection travels from bone to brain by this route.

If the inner table were as well supplied with blood as is the outer table, it is probable that, with destruction of periosteum, there would only be a loss of the corresponding outer table of the bone, the nutrition from the under surface keeping the inner table intact.

This, however, is not the case, for in each of our specimens we find the outer table entirely destroyed, most of the inner table present, but presenting an irregularly circular necrosed area, corresponding to the centre of the destroyed outer table.

This indicates that the circulation is entirely unable to preserve the outer table, and we may expect it, in any case of extensive burn, to be cast off. The circulation in the inner table is sufficient to preserve the life of a large part of this table, but the central portion gives way, the entire thickness of bone being cast off and leaving the dura exposed.

Blood reaches the venous channels of the diploë directly through the bone overlying and underlying a given part, and the circulation must be free in a lateral direction from a given point. Hence, if the periosteum is destroyed over a given area, the direct blood supply from this area is cut off, and the blood supplied the underlying area must reach it from the dura below the inner table, and laterally from the zone of healthy bone around the margin.

Under the centre of the denuded area lies the part furthest removed from the healthy margins, and here the venous thrombosis and superadded infection are greatest, and the inner as well as the outer table are destroyed and cast off.

In most cases of this sort, no doubt the exfoliation of the exposed skull will continue in a favorable manner and without infection of the dura and the brain, but the course of the first of my cases shows that such will not always be the case.

When the periosteum over these large areas is destroyed, we may be sure that necrosis will follow, and I have endeavored to find out what could be done to prevent such a disastrous termination as followed the waiting plan in Case I.

It occurred to us that one might chisel off the outer table over the entire denuded area, and graft the surface of bone as soon as it showed satisfactory granulations. However, upon

examining a parietal, an occipital or a frontal bone, one at once sees that there are very thin areas, of considerable extent all about these bones, where the internal table is not distinctly separated from the external table, and where one could not remove the outer without the inner table. Indeed, on several fresh cadavers we were unable to make any satisfactory removals after this plan.

In the first case, which died thirty-one days after receipt of the injury, we found that the necrosed bone had not begun to separate at the end of four weeks, and in the case that finally recovered, we found that it was at least three and one-half months before separation was complete. From this we know that a period approximating three or four months is required for separation and removal of sequestra.

We noted in the burns of all the bones of the vault of the skull, that the outer table was cast off over the entire area which is bared of periosteum but that the inner table is only destroyed over a small area corresponding to the centre of the necrosed outer table, and that the brain infection is received by contact with this inner area of inflamed bone.

If drainage is established at this central point, infection should not travel through the dura, and proper dressings ought to protect the brain until such a time as the rest of the necrosed bone is thrown off and the whole area covered with grafts.

Our suggestion for treatment is, therefore, that every such case be treated antiseptically until the sloughs of the soft parts have been cast off or cut away and the bone left bare and clean. This will only take a few days. 'After this, a trephine opening about half an inch in diameter should be made over the centre of the denuded bone, and the button removed down to the dura.

The wound should now be dressed antiseptically until such a time as the denuded bone is cast off, the drainage provided for at the centre being relied upon to take care of any infection which reaches the dura, after which the whole area should be grafted, as was done in our second case.

THE OPERATIVE TREATMENT OF CANCER OF THE LARYNX.*

BY GEORGE EMERSON BREWER, M.D.,

OF NEW YORK,

Surgeon to the Roosevelt Hospital.

CANCER of the larynx, whether considered from the point of view of the laryngologist or the general surgeon, presents one and the same problem. Can the victim of this dread disease be subjected to any form of treatment which will offer a probability or possibility of cure, or, if not, can anything be done to mitigate his sufferings?

From the earliest period at which the disease was recognized, not one authentic case of carcinoma of the larynx was ever cured except by early surgical removal of the disease.

As the death rate, therefore, in this condition treated by non-surgical methods has been, and is, 100 per cent., no time need be wasted in the consideration of non-operative treatment.

Four methods of radical surgical treatment have been proposed. First, intralaryngeal removal; secondly, thyrotomy, allowing exposure of the diseased area and removal of the lesion with subsequent closure of the laryngeal cavity; thirdly, partial laryngectomy; and fourthly, total laryngectomy.

While authentic examples of the successful removal of a malignant growth from the larynx by intralaryngeal methods have been recorded by Franckel and others, and while in a few rare instances freedom from recurrence has been observed for a sufficient length of time to justify the belief that a radical cure has been obtained, the gross uncertainties of such a procedure, and the almost uniformly disastrous results which have followed the method, have led to its general condemnation and abandonment.

Thyrotomy or laryngotomy, although first performed by

Brauers in 1833, was slow in acquiring surgical popularity, ·
largely from the fact that in the beginning only advanced cases
were operated upon and the results were correspondingly dis-
appointing. Von Bruns, forty-five years later, in 1878, suc-
ceeded in collecting only 19 cases in which the operation was
attempted for undoubted malignant growth. Of these, two
died from the effects of the operation. Of the 17 who sur-
vived the operation not one was known to live more than a
few months, the longest being the case of Sands, in which
death occurred without local recurrence 22 months after the
operation, but in which autopsy revealed metastasis in the
kidney and suprarenal gland.

The publication of this report served for a time to dis-
courage further employment of this method, until 1889, when
Butlin again advocated the operation, and demonstrated that
in early cases of intrinsic cancer, while the growth was limited
to the vocal band or adjacent soft parts, thorough removal
gave a fair chance for radical cure. In 1900 this author re-
ported to the International Congress at Berlin, 27 cases of
thyrotomy for malignant disease, with 3 deaths, and 3 cures
of three years duration. Last year (1908) Mr. Butlin re-
ported to the International Congress of Surgery at Brussels,
21 personal cases operated upon since 1890 with one death, and
12 patients alive and well three years after operation. At the
same meeting Gluck reported nine personal cases of carcinoma
treated by this method without mortality, 7 remaining well
without recurrence,—period of time not stated; one submitting
to a total laryngectomy six months after operation for recur-
rence, and one dying 2½ years after with visceral metastasis.

Semon, who with Butlin was one of the pioneers in the
modern plan of treating all early intrinsic cases by this method,
reports 19 personal cases with one death, 76 per cent. of cures
lasting one year (he never having observed a recurrence after
the first year). Since Semon's masterly presentation of the
subject in America in 1904, the operation has steadily grown
in favor, and is to-day the operation of choice in early
cases of intrinsic cancer. I can not do better in this connec-

tion, than to quote Semon's advice regarding indications. " All intrinsic cases of cancer, not too extensive, not too near the posterior wall and not infiltrating the cartilages ought to be treated by thyrotomy."

Partial or hemilaryngectomy, first practiced by Foulis in 1878, is indicated in cases of unilateral intrinsic disease in which the lesion extends too far backward to promise a favorable result by simple thyrotomy, or when there is reason to believe that the perichondrium or cartilage is involved. As early as 1884 Hahn showed that the mortality was far below that of total laryngectomy. In 1897 Sendzick published 110 cases with a death rate of 26.3 per cent. Chiari reported 32 cases with 8 deaths, or 25 per cent. In 1902 Hartley reported 4 personal cases without mortality, and last year Gluck reported his own series of 43 cases, also without mortality.

Regarding the permanent results following this operation, Powers and White in 1895 recorded 101 cases, with 8 alive and well three years from the date of operation. Butlin in 1900 reported a series of 23 cases, of which 4 were free from recurrence at the end of three years.

Of Gluck's 43 cases, 5 of carcinoma and 2 of sarcoma were alive at the end of three years, while 13 had recurrence and later submitted to total laryngectomy.

Although the indications for this operation are not as frequently encountered as for thyrotomy or total laryngectomy, it has the great advantage that it preserves the normal oral or nasal respiration, and not infrequently allows the patient to retain a speaking voice of fair quality.

While there is a widespread impression that at present the mortality of this operation is higher than that of total laryngectomy, due to the fact that there is more difficulty in completely protecting the air passages from the secretions of the wound and pharynx, the statistics of Hartley and Gluck show that with careful technic the death rate is as favorable as in any of the other major operations in this region.

Total laryngectomy was first performed by Watson of Edinburgh in 1866. He was followed by Billroth, Heine,

Maas, Czerny, and others. The first successful laryngectomy for malignant disease was that of Bottini, whose patient lived six years.

During the earlier period of this pioneer work, the results were so unfortunate, both as regards immediate mortality, and permanent cures as to render the procedure almost prohibitive.

Hartley, in a careful statistical review of the operation published in 1902, showed that prior to 1889 the death rate from operation was between 40 and 50 per cent., and the permanent cures only 7 per cent.

The cause of the immediate mortality of this operation was recognized by all careful observers to be, first the occurrence of inhalation pneumonia, and second the extension of infection from the wound downward along the cellular planes of the neck to the mediastinum.

The first notable advance in technic was that proposed by Gluck in 1881, who suggested and practiced prophylatic resection of the trachea and implantation of the distal extremity through a buttonhole cutaneous wound just above the suprasternal notch, thus cutting off all connection of the air tube with the wound and preventing thereby the entrance of pharyngeal mucous and wound secretions. He also advised complete closure of the pharyngeal wound and generous packing with iodoform gauze. The employment of the Trendelenberg posture successfully prevented the entrance of blood into the trachea during the operation, which still further reduced the immediate risk.

Since this period the reported results show a steady improvement. Terebinski, in 1904, collected 188 cases with a mortality of 27.7 per cent. Schmiegelow collected 54 operations between 1890 and 1897 which showed a death rate from operation of 22 per cent. Moline, 81 cases with 15 per cent. mortality. Jackson 9 personal cases with one death, or 11 per cent. In Gluck's latest report, made to the International Surgical Congress at Brussels last September, he gives a total of 128 personal cases, and states that he has had no operative

... for the past four years in uncomplicated cases of total
laryngectomy.

Regarding the end results of total laryngectomy for
malignant disease, von Bruns from statistics collected in 1890
gives 10 per cent. of cures three years from the date of opera-
tion. Powers and White in 1895 collected a series of 208
cases, of which 15 were known to be living at the expiration
of three years. If we deduct 73 who died as a result of these
operations from the total number, it gives a percentage of 3
years cures of 11. Hartley in 1902 estimated the permanent
cures as 15 per cent. In 1908 Gluck reports, of 128 opera-
tions 20 patients were alive and free from recurrence at the
end of three years, or a trifle over 15 per cent.

Two operations have been suggested to diminish the suffer-
ing in advanced and inoperable cases, tracheotomy and the
starvation treatment recommended by Dawbarn. We are all
aware of the relief which tracheotomy gives to the patient
whose cancer has advanced to the stage of laryngeal stenosis,
and who is hourly dreading asphyxiation. The discomfort
and annoyance of the tracheal cannula are gladly accepted by
these unfortunate patients in place of the painful spasm, dis-
tressing cough, and increasing difficulty in obtaining oxygen.

Regarding the starvation method or cutting off the chief
arterial blood supply to inoperable malignant growths in and
about the larynx, it may be said that it is deserving of a trial
particularly in cancerous growths situated at the superior
aperture of the larynx with marked dysphagia and constant
cough. It must be borne in mind, however, that the typical
Dawbarn procedure, that of complete extirpation of both
external carotids was intended for growths of the face, lips,
tongue, mouth, and upper pharynx. As the larynx is supplied
chiefly by the superior and inferior thyroids, ligation of three
of these trunks will accomplish all and more in these cases, than
the typical carotid extirpation.

The writer's experience is limited to a single patient, but
the relief in this instance was so striking that a brief history
of the case will be given.

A middle-aged man, a butler by occupation, was admitted to the Roosevelt Hospital in the spring of 1901 suffering from hoarseness, a severe spasmodic cough, difficult and painful deglutition. He had suffered from these symptoms for three or four months, and had lost 10 or 15 pounds in weight, chiefly from loss of sleep and an inability to swallow food in sufficient quantities to maintain his strength.

On examination, a large indurated ulcer was seen involving the intra-arytenoid fold, somewhat more to the right than the left of the median line. There was moderate involvement of the adjacent lymphatics. He refused radical removal on account of the dangers and uncertainties of result, but gladly consented to the palliative operation.

Under chloroform anæsthesia, the right superior and inferior thyroid arteries were exposed and ligated, and also the left superior vessel. Within 48 hours he experienced a marked change in all of the painful symptoms. He slept without coughing, and was able to swallow with progressively increasing comfort. The wounds healed kindly, he left the hospital, and returned to his work. An examination made by several members of this society three weeks after the operation, showed that the ulcer had been reduced in size, and the surrounding tissues had lost their œdema and acute hyperæmia. He continued in this comfortable condition for several months, but later submitted to a tracheotomy for stenosis. The man expressed the greatest gratitude for the relief he obtained, and his life was undoubtedly prolonged by the treatment.

As the writer has had no personal experience in intra-laryngeal removal of cancerous growths, or in hemilaryngectomy, he will report briefly his experience with thyrotomy and laryngectomy.

Thyrotomy I have performed 16 times with one death. Of these 16 cases only 7 were for undoubted carcinoma.

CASE I was that of a colored woman 41 years of age, with a recurrent epithelioma of the vocal cord. She recovered from the operation. Four months later she showed signs of a rapid recurrence, and total laryngectomy was performed (see Case I, under laryngectomy).

Case II was that of a middle-aged woman who had had symptoms of papilloma for two or more years. As the growth began to infiltrate the cord, she was referred to the writer by her physician, Dr. Charles H. Knight of this city. Under chloroform anæsthesia a median incision was made in the thyroid cartilage, the interior of the larynx widely exposed, the growth removed from the vocal cord and submitted to immediate microscopic examination by frozen section. As the diagnosis was epithelioma, the surrounding soft parts were thoroughly removed to the cartilage, the larynx packed, and the tracheal cannula left in place. She recovered nicely from the effects of the anæsthetic, slept quietly for nearly an hour, then suddenly awoke with a violent paroxysm of coughing in which the tube was expelled, and she died before it could be replaced.

Case III.—A man, 50 years of age, from Nanuet, N. Y., was admitted to the Roosevelt Hospital in July, 1904, suffering from a small intrinsic epithelioma of the left vocal cord. This was removed by thyrotomy, and the microscopic examination confirmed the diagnosis. He made a satisfactory convalescence, and remained well for two years and eight months, when he died of lobar pneumonia without any symptoms of a return of his laryngeal trouble.

Case IV.—Man, 49 years of age. Symptoms of laryngeal growth on left vocal cord for about one year. As the growth began to infiltrate the tissues of the cord, he was referred by Dr. H. Holbrook Curtis to the writer for radical removal.

On October 6, 1903, thyrotomy was performed, and the left cord and surrounding soft parts to the cartilage removed. He made a satisfactory recovery. Microscopic examination of the specimen showed it to be epithelioma. Two months later he returned, suffering from an apparent recurrence. A second thyrotomy was performed and a granulation removed together with a small area of the adjacent cartilage. His recovery from the second operation was uneventful. Examination of the specimen showed only granulation tissue. Two weeks ago I examined this patient and found no trace of his former disease, five years and eight months from the date of his first operation.

Case V.—A man, aged 60, was admitted to the Roosevelt Hospital, in July, 1906, suffering from a small nodule on the left vocal cord. Exposed by thyrotomy the growth was removed

together with the adjacent soft parts to the cartilage. Microscopic examination of the specimen proved it to be epithelioma. He made a smooth recovery, but two months later returned with a slight recurrence. A second thyrotomy was performed and the growth removed together with a portion of the adjacent cartilage. He recovered from the second thyrotomy, only to return six months later for a terminal tracheotomy.

CASE VI.—A man, 54 years of age, was admitted to the hospital in August, 1905, with carcinoma of one vocal cord. The diagnosis was confirmed by microscopic examination of the specimen removed by Dr. Jonathan Wright. Thyrotomy, with complete removal of diseased area. Smooth convalescence, patient left the hospital on the twenty-second day. Nine months later the patient was re-admitted with a recurrence which involved both sides of the organ, and submitted to total laryngectomy. (See Case VIII of laryngectomy.)

The technic followed in these cases has been practically the same, and was modelled upon that practiced by Butlin and Semon. In my first case I undertook a preliminary tracheotomy. On the second day, however, there was a sharp rise of temperature, with cough and pains in the chest. The cannula was immediately removed and the symptoms subsided. A week later she was again tracheotomized and thyrotomy and removal carried out at the same time.

The anæsthetic has been chloroform in the majority of instances, although ether has been employed in a few later.

A median incision is made from the upper border of the thyroid to a point just above the suprasternal notch. The lower part of this is deepened and the trachea exposed. When all bleeding has been arrested, the trachea is opened and a sponge plug or tampon, to which has been tied a double loop of strong silk, placed in the upper segment of the air tube, the distal end of the silk loop clamped with an artery forcep and the cannula introduced. From this time the anæsthetic is administered through the tracheal cannula. The upper part of the incision is next carried down to the cartilage, the thyrohyoid membrane incised, and the thyroid, cricothyroid membrane, and occasionally the cricoid cartilage, divided in

the median line, freely exposing the laryngeal cavity. The two halves of the larynx are next widely retracted and the mucous membrane swabbed with a 4 per cent. solution of cocaine, or cocaine and adrenalin. If any doubt exists regarding the competence of the sponge tampon it is re-inforced by gauze packing from above, to prevent the possibility of blood entering the trachea. The growth is now examined and its extent appreciated. If the case is a suitable one for removal by this method, the tumor, together with a generous margin of healthy tissue, is removed down to the cartilage. Bleeding points are controlled by clamps and fine catgut, by the use of peroxide of hydrogen, or the small cautery point. In my earlier cases I packed the laryngeal cavity with one piece of fluff gauze after removal of the sponge tampon and any gauze employed for preliminary packing of the trachea. The packing was generally removed on the second day, the cannula on the third. Recently I have omitted the postoperative packing, and removed the cannula on the day following the operation.

The only case in which I have departed from the above outlined technic, is one in which I omitted the tracheal plug, but depended upon Rose's position to prevent blood from entering the trachea, and used a rectangular incision.

The personal experience of the writer in total laryngectomy is limited to eleven cases. Of these, five died as the result of the operation and six recovered. Of the six that survived the operation, one woman is alive and well ten years and three months from the date of her operation. One man is alive and free from recurrence three years and one month after operation. A third patient alive and well two years and four months. Of the other three, one died of pneumonia shortly after operation, one had a recurrence four months after his discharge from the hospital, and a third the most favorable case of the series, was free from recurrence when last seen, but since that time we have been unable to trace him.

CASE I.—Colored woman, 42 years of age. Had what was supposed to be a small non-infiltrating papilloma removed from her left vocal cord in the summer of 1898 by Dr. F. C. Ard of

Plainfield. He kept the specimen, but felt so sure of its benign . nature, that he did not have it examined microscopically. Six months later she returned with a small recurrence. He then had the original growth examined. It was pronounced epithelioma by the pathologist of the Presbyterian Hospital. Case referred to the writer for thyrotomy; this was done on November 24, 1898 (see Case I, thyrotomy series).

In February, 1899, I received a hasty summons to the Muhlenberg Hospital in Plainfield to see the patient, who was suffering extreme dyspnœa. On laryngoscopic examination, nearly the entire interior of the larynx was found to be filled with recurrent growth. She was offered the choice of a tracheotomy with temporary relief, or of total laryngectomy with a possibility of radical cure. She eagerly accepted the latter. Under chloroform and oxygen anæsthesia, after a low tracheotomy and plugging the upper segment of the trachea, the larynx was exposed and dissected from the surrounding soft parts. Both superior thyroid arteries were secured near their orifices, the superior laryngeal nerves divided and the lymph-nodes and lymph-bearing areolar tissue in the neighborhood removed. The trachea was next divided about the first ring, and the larynx separated from the œsophagus, and finally removed by cutting through the thyrohyoid membranes. The pharyngeal wound was closed with two layers of silk, the tracheal cannula left in place, the wound partly united and packed with gauze.

A moderate reaction followed the operation. Water was swallowed the fourth day. On the fifth day, as a result of a violent paroxysm of coughing, the pharyngeal wound opened. In other respects she continued to do well, and was discharged from the hospital four weeks later. She was shown to this Section on March 22, 1899, by Dr. F. C. Ard. She is still alive and well, ten years and three months having elapsed since the operation.

CASE II.—A man, 51 years of age, suffered from cough and hoarseness for ten months. Referred to the Roosevelt Hospital by the laryngological department of the Vanderbilt Clinic, with diagnosis of carcinoma. Preliminary tracheotomy December 17, 1901, total laryngectomy two days later. Death from sepsis extending to mediastinum, and inhalation pneumonia on the tenth day.

The writer was strongly impressed that the preliminary tracheotomy was a mistake in judgment in this case, as considerable reaction and cough followed, which had not entirely subsided in the two days which had elapsed since the first operation. We resolved not to employ it in the future, but to employ the same technic which was carried out in the first case.

CASE III.—A middle-aged man was referred to the writer in the autumn of 1902, suffering from cough, loss of voice and dyspnœa on exertion. The duration of the symptoms is not mentioned in my notes, but the disease was well advanced, and considerable loss of bodily weight and strength had occurred. The case was seen by a number of laryngologists, all of whom confirmed the diagnosis of epithelioma.

Under chloroform anæsthesia, total laryngectomy was carried out by the same technic as in Case I. Very little reaction followed the operation. The wound was dressed daily, and the amount of infection was trivial. He took water on the second day, and sat up in bed on the third. A leak occurred in the pharyngeal wound, and he was thereafter fed through a tube. He left his bed on the tenth day, and three or four days later was presented to my class as an example of a successful laryngectomy, although a small pharyngeal fistula was still present. A day or two later he passed the entire afternoon in the open air, and in the evening had a chill and rapid rise of temperature. Lobar pneumonia developed, and he died in three days.

CASE IV.—Male, aged 65, with advanced disease. Operated upon at the Roosevelt Hospital on May 6, 1903. The same technic was followed as in the last case. Pneumonia developed almost immediately, and death followed on the fifteenth day.

CASE V.—A healthy Adirondack guide about 45 years of age, was admitted to the hospital suffering from extensive intrinsic disease, involving both sides of the larynx. My notes in this case are defective, but I remember distinctly regarding him as a particularly good operative risk, in spite of the rather advanced stage of the disease. He was operated upon in the same manner as the last two cases. There was no shock and he showed no untoward symptoms for 24 hours. On the second or third day he developed pneumonia and died.

Reviewing my results up to this period, it will be seen

that of five patients, only two recovered from the immediate effects of the operation, and only one remained well. All died of pneumonia: a death rate of 60 per cent. About this time I became interested in the remarkable results obtained by Gluck of Berlin, he having reported a series of 22 total laryngectomies, with but one operative death. Feeling, as I did, that my unfortunate results were due to technical errors, I resolved to visit Berlin and see Gluck's work. I was cordially received, and as a result of my observations found that his method differed from the one I had employed in several particulars. He employs no preliminary tracheotomy; he uses the Trendelenberg posture; he exposes the region by a rectangular cutaneous flap. He first opens the air passage from above, through the thyrohyoid membrane, and then removes the larynx from above downward; he draws the trachea outward from its bed, and attaches it to the cutaneous wound just above the sternal notch; he immediately introduces a feeding tube through the nostril into the stomach, and administers food at an early period. He also employs more generous tamponade of the wound, using iodoform gauze.

In following the after treatment of some of his cases, I observed no pneumonia and no evidence even of marked tracheal irritation. Patients were given an abundance of food as soon as they could retain and digest it. This to me appeared a most important factor, as the painful deglutition and fear of leakage from the pharyngeal wound had kept my patients on a very limited diet for many days; and as the patients are for the most part old and feeble, with little resistance, the question of adequate nourishment seemed an important one. I returned home full of enthusiasm, resolved to carry out Gluck's technic to the letter. Two cases presented themselves shortly after my return, both, however, with advanced disease.

CASE VI.—A man, aged 43, who had suffered from hoarseness and pain for two years. He also had progressive difficulty in swallowing, and a loss of 40 pounds in weight. Laryngoscopic

examination revealed an ulcerating epithelioma involving the superior aperture of the larynx.

CASE VII.—Also had extensive disease, but was otherwise in fair general condition.

Both of these patients were operated upon in the same manner, and the technic of Gluck was carried out to the letter. The postoperative course was similar in each instance. Neither suffered appreciably from shock. Both cases, however, quickly developed a peritracheal infection, favored in my judgment by drawing the trachea from its bed and opening up the deep cellular planes of the neck. Case VI, whose resistance was low, quickly succumbed to pneumonia and acute mediastinitis. Case VII, whose resistance was greater, continued his uphill fight against sepsis for a number of days, but at last died of acute mediastinal cellulitis and pneumonia. In the latter case the trachea quickly became detached from the skin and retracted below the upper border of the sternum, where it lay in a mass of necrotic tissue.

The result in these two cases was disappointing in the extreme. In reviewing the several steps of the operation I was convinced that there was no advantage in the rectangular flap, that the removal of the larynx from above downward presented more technical difficulties than from below upward, and in my hands resulted in a larger pharyngeal wound with greater risk of leakage and subsequent infection. I was absolutely convinced, also, that the plan of stripping the trachea from its bed was unwise, as it opened up the deep cellular planes of the neck to the always present and unavoidable infection from the tracheal secretions, and from any subsequent leakage which might occur from the pharynx.

I resolved, thereafter, to perform a preliminary tracheotomy at least ten days before removal of the larynx. At this operation I would also, as suggested by Crile, divide the isthmus of thyroid, expose the trachea for a considerable distance above the tracheal opening, and by means of iodoform gauze packing create an area of granulation tissue around the trachea which would prevent subsequent retraction and offer an effectual barrier against infection travelling downward in the peritracheal tissues. At the secondary operation I would not

attempt to raise the trachea from its bed in order to stitch its lumen to the skin, but, as suggested by Koschier, would content myself with destroying with cautery its mucous membrane above the cannula, and by frequently repeated packing prevent the entrance of wound secretions, both during the operation and during the subsequent dressings. This plan has been followed in the four operations I have performed since that time. In addition I have introduced the nasal stomach tube at the time of operation, and kept in place from 7 to 10 days, feeding the patients as soon as possible after operation. By following this plan I am able to report that all of the four patients made satisfactory recoveries. A brief résumé of each may not be out of place.

CASE VIII.—A laborer, aged 55 years, was admitted to the Roosevelt Hospital in May, 1906, suffering from recurrent carcinoma (see thyrotomy series, Case VII). Laryngoscopic examination showed a bilateral epitheliomatous growth. Preliminary tracheotomy and packing of wound. At the secondary operation the larynx was removed from below upward, the tracheal stump being left in place and securely packed. Patient made a satisfactory recovery, and was discharged in about four weeks.

CASE IX.—A female, aged 30, suffered for seventeen months from hoarseness, and a slight pain on left side of throat for two months. Laryngoscopic examination showed intrinsic growth situated on left cord and extending slightly to the right of median line. Diagnosis confirmed by microscopic examination of fragment. Preliminary tracheotomy in the manner above described. Twenty-three days later total laryngectomy under colonic anæsthesia. Smooth convalescence. Discharged on the twenty-eighth day.

CASE X.—The history of this case has been lost. Patient admitted to the hospital in moderately severe dyspnœa with extensive carcinomatous growth. Preliminary tracheotomy under chloroform. Secondary removal of larynx under colonic anæsthesia ten days later. Early feeding through nasal tube. Convalescence was uneventful. Six months later patient returned with recurrence in· the tissues of the neck and was referred to the Department of Charities for future care.

CASE XI.—The history of this case has already been reported by Dr. Harmon Smith, by whom he was referred to the writer. Briefly, the history was of tumor of the larynx of ten years duration. The tumor involved the left vocal cord and adjacent structures. Microscopic examination of a fragment removed by Dr. Jonathan Wright showed undoubted malignancy. Pheliminary tracheotomy followed in fourteen days by total laryngectomy. Convalescence was rapid and uneventful. When last seen, five months after operation, there was no sign of recurrence. Since that time we have been unable to trace him, and his present condition is therefore unknown.

The rapid and satisfactory convalescence which occurred in the last four cases contrasts so strikingly with the results which followed my earlier operations that one is strongly inclined to the opinion that it must be due to the changed technic. While I lost one case of my earlier series in which I performed a preliminary tracheotomy, it must be remembered that I allowed only two days to intervene between it and the secondary operation,—a period far too short in which to establish a successful granulation barrier against peritracheal infection.

To recapitulate, my technic in total laryngectomy is:

Under general anæsthesia, after the usual local preparation, a median incision is made extending from the cricoid to the sternal notch. The muscles are separated, exposing the isthmus of the thyroid, which is double ligated and divided. The separated edges are pushed to each side and the trachea freely exposed. A low tracheotomy is then performed and the cannula introduced, after which the upper part of the incision is united with silkworm gut sutures, and the peritracheal space generously packed with iodoform gauze both above and below the cannula (Fig. 1). The wound is dressed and the patient placed under a tracheotomy tent into which a small amount of steam is introduced by means of a croup kettle. The external opening of the tracheal cannula is constantly covered with four or five layers of gauze wet in warm boric acid solution, with a view of filtering the air which enters the
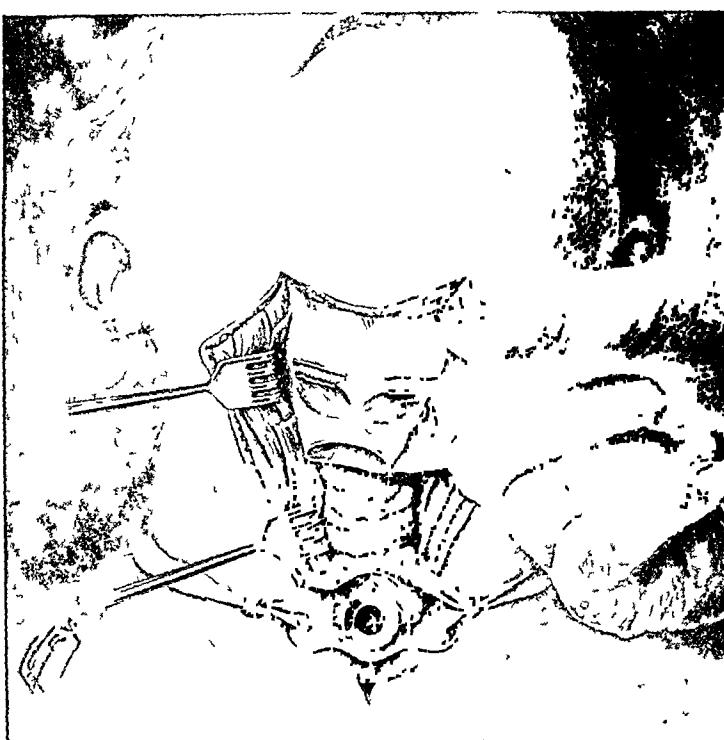
FIG. 1.
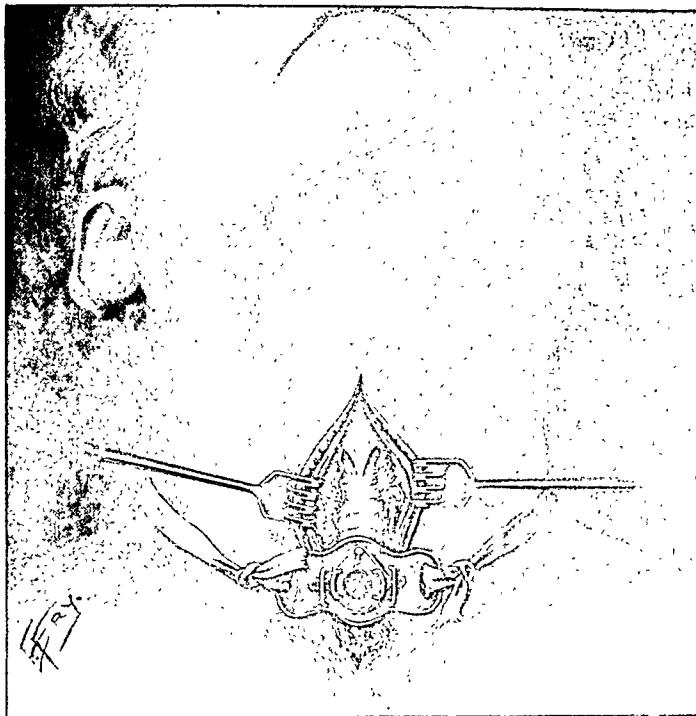
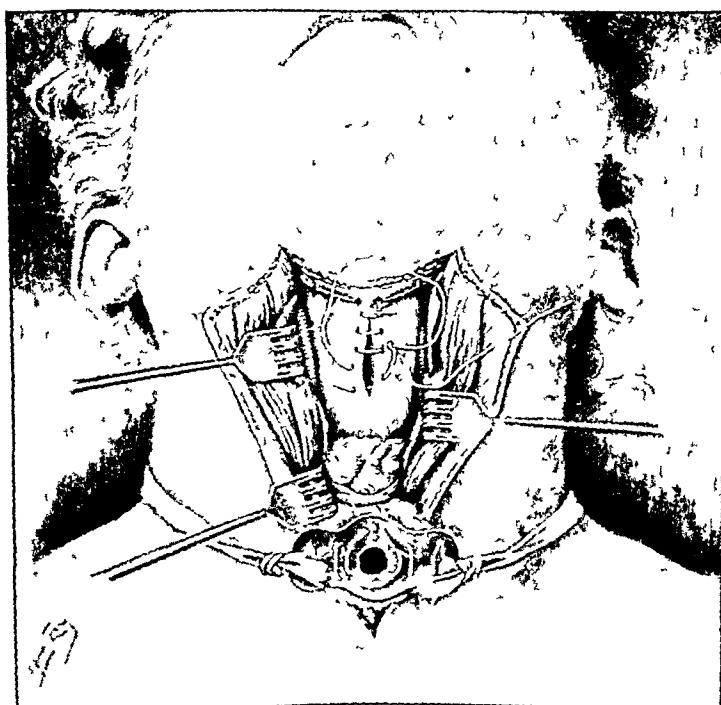Preliminary tracheotomy with peritracheal tamponade.

FIG. 2.
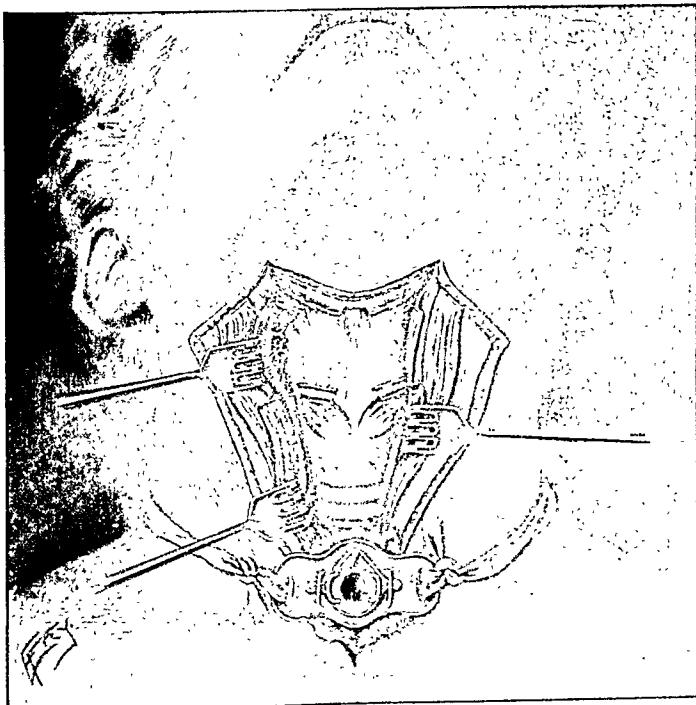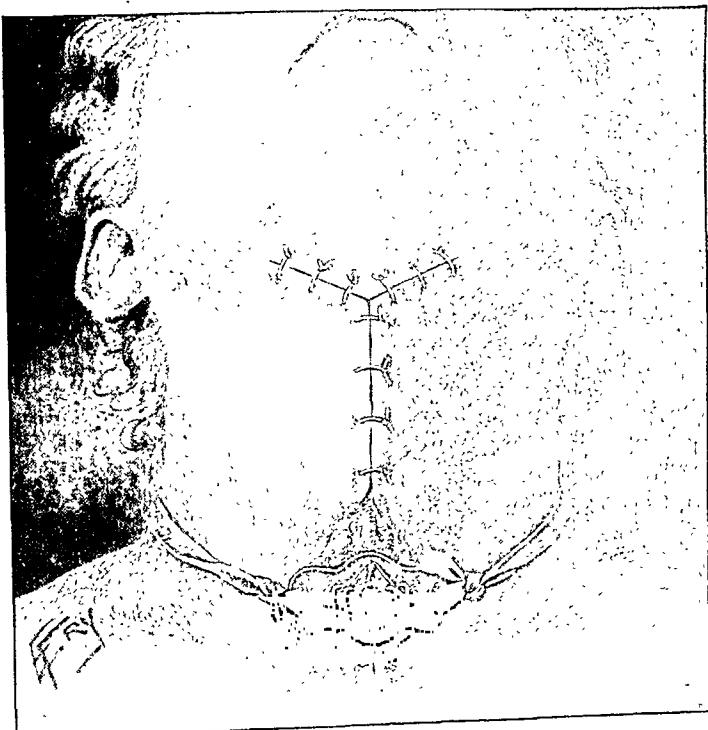

Exposure of the larynx and thyrohyoid membrane

FIG 3

Division of the trachea, and separation of the larynx from the œsophagus

FIG 4.

Suture of the pharyngeal wound and packing the upper segment of trachea

Fig. 5.

Wound closed, with generous gauze packing about tracheal stump.

trachea. A special day and night nurse attends the patient. About ten days after the preliminary operation, if the patient has a normal temperature and is not suffering from cough and excessive tracheal secretion, the secondary operation is undertaken.

Chloroform is administered through the tube until the patient is anæsthetized, after which its administration is continued in the same manner, or colonic etherization is employed by means of the Sutton apparatus. The use of scopolamine 1/100 gr. and of morphine 1/6 gr. one-half hour before operation is a decided advantage in these cases, as it not only diminishes to a considerable extent the amount of anæsthetic required, but lessens the post operative vomiting, and insures a period of from one to four hours of freedom from restlessness after the operation, a period when most laryngeal cases are coughing and vomiting, and increasing thereby the always present tracheal irritation.

The patient is placed on a flat table with the head well extended. An incision is made from the body of the hyoid downward to the upper limit of the former cut. From the upper extremity of this incision two lateral incisions are made in an upward and outward direction extending to the anterior borders of the sternomastoid muscles. The two triangular flaps are turned outwards, the sternohyoid muscles divided just below their attachment and the sternothyroids detached from the cartilage (Fig. 2). The two superior thyroid arteries are next located and ligated. The superior laryngeal nerves are cut and all lymph-nodes and neighboring lymph-bearing areolar tissues are removed. The attachments of the inferior constrictors are next divided and posterior surface of cricoid partly separated from the œsophagus by blunt dissection.

When the larynx is thoroughly skeletonized, the tracea is severed just below the cricoid, and its distal extremity immediately packed tightly with gauze, completely preventing the entrance of blood or pharyngeal mucus. The forefinger of the left hand is next introduced into the upper or laryngeal segment of the tube, and the larynx gently raised from the

œsophagus, any remaining attachments being separated by
gauze sponges (Fig. 3). When the larynx is thus completely
separated from the œsophagus, the tips of the thyroid cornua
are divided, the thyrohyoid membrane incised and the larynx
removed.

The pharyngeal wound is then packed with gauze to pre-
vent excessive contamination of the wound, and the parts care-
fully inspected for evidences of remaining disease. The oval
pharyngeal wound is next tightly closed by two layers of
suture, the first of plain catgut, the second of chromic catgut
(Fig. 4). After closure of the pharyngeal opening, the entire
upper wound is temporarly packed with wet formalin gauze,
while the tracheal stump is prepared for closure. This is ac-
complished by removing redundant tissue above the cannula
opening, dissecting out or destroying with cautery the mucous
membrane, and packing firmly with iodoform gauze above the
tube. A No. 30 F. rubber feeding tube is then introduced
through the left nostril into the œsophagus, and secured by a
safety pin and plaster straps to the face. The wounds are
next united above, with generous gauze packing about the
tube (Fig. 5.)

The after-treatment is the same as following the pre-
liminary tracheotomy. Water is given through the tube as
early as the morning following the operation, if there is no
nausea. Milk, coffee, egg nogg, meat juice, and soups follow
as soon as possible. No attempt at swallowing should be
made for at least seven days, after which the tube can be
removed. The wound should be dressed at least once every
day, and two or three times if there is infection or pharyngeal
leakage. The tracheal stump is quickly covered with granula-
tions, and gives no trouble. The patients continue with the
silver cannula.

THE CLOSURE OF THE WOUND AFTER THE RADICAL AMPUTATION OF THE BREAST.

BY JOSEPH WIENER, M.D.,

OF NEW YORK,

Adjunct Surgeon, Mount Sinai Hospital.

HAVING recently had occasion to do three radical amputations of the breast for carcinoma within twenty-four hours, the method of closing the extensive wound was brought up for discussion by one of the assistants, who expressed surprise at the method I employed. The method is the one I have used in all my cases, with slight modifications, during the past ten years. To quote from an article by J. C. Warren of Boston: " The closure of the wound in this operation has always been a difficult problem, since it has been decided that the whole integument of the breast should be included between the incisions. Any method which permits of an easy approximation of the edges of the wound is out of date. The method of grafting adds materially to the length of the operation and leaves a most unsightly scar. The removal of the breast is at best a demoralizing ordeal to most patients, and every effort should be made to procure as rapid healing and as little unsightly a cicatrix as possible." Halsted, on the other hand, says: " To attempt to close the breast wound more or less regularly by any plastic method is hazardous and, in my opinion, to be vigorously discountenanced. The oval flap, whatever the direction of its long axis, removes, so far as the cure of the disease is concerned, a circle of skin whose diameter is not greater than the short axis of the oval. I still believe in the removal of a very large circle of skin and endorse the remark of my ex-house surgeon, Dr. Follis, that the operator whose duty it is to close the wound should not be entrusted with the planning of the skin incision." Halsted acknowledges that the grafting does interfere with very early arm movements.

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The two opinions quoted above represent fairly well the diverging views still held in regard to closure of the wound after the radical operation. We believe the opposing views can be harmonized. No one will gainsay that a grafted area after breast amputation tends to form an unsightly scar. I have seen such scars months later, and they are not things of beauty. On the other hand, it will be said that we are not doing a cosmetic operation, but a deliberately mutilating operation designed to permanently cure an extensive carcinoma. Perfectly true; just as it is perfectly true that a large circle of skin should be removed with the breast. But are we justified in concluding from these premises that we must use grafts to cover such an area, that we must unnecessarily prolong the length of the operation, that a plastic operation is to be deprecated and that our unfortunate patient must carry around a most disagreeable scar? Such would seem to be the conclusions of those who, as a routine procedure, without attempting to close the wound completely, regularly use skin grafts in every operation of this kind. The writer rather tends to agree with the views of Warren, that the removal of the breast is a sufficiently demoralizing ordeal to warrant our making every effort, *consistent with the safety of our patient,* to bring about a speedy recovery with the best possible cosmetic result. In so doing we would not save the smallest piece of skin that we thought ought to be removed with the tumor. We believe in and practice a very wide excision of skin, together with breast, tumor, pectoral muscles and lymphatics. We do not allow ourselves to be influenced, when making the original incision, by any fear that we may not be able to subsequently close the wound. Our excision of skin is just as extensive as that practiced by those who graft in every case. It has frequently happened to the writer that an assistant or onlooker has expressed the opinion that it would be impossible to close the enormous wound without grafting. And yet during the ten years that we have practiced the radical operation we have in every case been able to cover the denuded area by transplanting the breast from the oppo-

FIG. 1.

First dressing after radical amputation of breast, six days subsequent to operation. The right breast before operation was almost in the axillary line. At the completion of the operation part of the breast overlapped the median line,—it has already been somewhat drawn back to the right side. Note distance of shot and plate sutures from edges of incision. Note supraclavicular drain emerging from stab wound.

The dotted line represents the usual incision,—it is carried around the lower border of the breast in the shape of an ellipse.

site side. No one, we believe, will deny that if we are able to close the wound in this way the resulting linear scar will be far more pleasing to the patient than a broad grafted area. Quite recently a private patient, an unmarried lady of 39, on whom the writer had performed this operation over six years ago, presented herself for observation. The wound had healed by primary union and the resultant linear scar was scarcely noticeable.

The incision is represented by the dotted lines in the illustration (Fig. 1). If the supraclavicular glands are to be removed through the same incision then the racquet-shaped incision rises more vertically upward towards the clavicle. In some cases these glands are removed through a separate incision. We always remove both pectoral muscles *in toto.* We begin our dissection by dividing the tendon of the pectoralis major, then dissecting backwards, remove axillary contents with the muscles, tumor, and breast all in one piece. By undermining the opposite breast and using shot and plate sutures any defect can be completely covered. The opposite breast is usually flabby and there is much redundant skin, so that the technical difficulties are usually not great. In several cases the nipple of the opposite breast at the end of the operation was in the median line; some part of the opposite breast regularly overlaps the median line. But so great is the elasticity of the skin that in a few weeks the breast has returned almost to its normal position. Furthermore, in many cases, the breast will be so flabby and pendulous that the nipple is almost in the axillary line before we begin our suturing. In such cases, at the end of a few weeks the breast will be found in a perfectly normal position, in spite of the fact that it was drawn over to the opposite side to cover the defect.

In mobilizing the breast a few free incisions are made behind the breast, the edges of the incision being forcibly pulled away from the chest wall. Much of this dissection can be done bluntly; a few vessels require ligation. The dissection, blunt or sharp, proceeds between the posterior surface of the breast and the fascia covering the pectoralis major.

The fascia itself should not be injured, but the loose areolar tissue between this fascia and the breast should be divided. This can be done in a few minutes; and the skin flap towards the axilla on the affected side, where the dissection has already been done, is freed as far out as possible. This should be especially thoroughly done at the lower angle of the wound, as it is near the lower end of the denuded area that most tension is usually encountered in passing the sutures. Two assistants now forcibly adapt the margins of the wound, and the amount of tension can then be readily ascertained. If necessary, the skin can be mobilized in a similar manner below the lower border of the incision; we have done this in most of our cases and it has helped us to close some wounds which we would otherwise have been unable to close. In one case where on account of the size of the tumor an unusual amount of skin had to be sacrificed, after mobilizing the opposite breast, we made two horizontal incisions, one above and one below the breast, and we were then able to bring (slide) the breast well over to the opposite side and thus close the enormous defect. But this procedure will rarely be necessary. It is really surprising how readily the usual defect can be covered by the above method. We use two or three shot-and-plate sutures and are careful to place them two and a half or three inches from the margins of the wound on each side. Since using a small thick pad of gauze between the lead plate and the skin, we no longer see the little area of necrosis due to pressure of the plate against the skin. Heavy silkworm is used for this suture, a perforated lead bullet is fastened to the end of the suture, then comes the perforated lead plate with edges slightly turned up away from the skin. The free end of the suture to which the needle has been added, is passed through the centre of the small gauze pad. This pad should overlap the edges of the lead plate at least a quarter of an inch all around. The needle is then passed through both skin flaps at some distance from the edges. Without unthreading the needle, it is passed through a second gauze pad which is pulled down close to the skin. The needle is then removed and the silkworm suture

passed through the lead plate and lastly through the perforated bullet.   An artery forceps is placed on the end of the suture and the other tension sutures are passed in a similar manner. These sutures are prepared before the operation, and take but a minute to apply.   An assistant forcibly approximates the edges of the wound by crowding the breast over towards the affected side.   The operator quickly adjusts the shot-and-plate sutures, and a running suture of fine silk accurately brings together the edges of the skin.   The arm and shoulder portions of the incision can be partly approximated with strips of Z. O. plaster.   Drainage is provided for in the usual manner by a tube introduced through a stab opening low down in the posterior axillary line.   If the supraclavicular glands have been removed without making a separate skin incision, this space is drained through a small opening in the skin above the clavicle.   The first dressing is done on the sixth or seventh day and all sutures are then usually removed. After removing the sutures we are accustomed to keep the skin edges approximated with numerous strips of Z. O. plaster.

This simple method of wound closure has been so satisfactory in our hands, and so gratifying to our patients, that we feel justified in recommending it to others.

THE POSTOPERATIVE TREATMENT IN CASES OF TYPHOID PERFORATION.

REPORT OF FOUR CONSECUTIVE CASES OPERATED UPON WITH RECOVERY.

BY PEREGRINE WROTH, Jr., M.D.,

OF HAGERSTOWN, MD.

DURING my term as Resident Surgeon at the Union Protestant Infirmary of Baltimore, 1907–1908, I had the opportunity of caring for four cases of typhoid perforation. After having operated on these cases I was able to employ the so-called Fowler-Murphy treatment of peritonitis with the result that all four cases recovered.

The object of this paper is to call attention to the modified Fowler-Murphy treatment of general peritonitis as applied to the peritonitis following the perforation of typhoid ulcers, emphasizing the fact that under such conditions the primary disease may be disregarded almost with impunity and the patient placed in an upright position and kept there for days, if need be, without experiencing any ill effects.

Previous reports have laid stress on the need for drainage, but have regarded the patient as still demanding rest in the recumbent position and have relied on flank incisions to secure drainage by gravity.

The four cases on which I operated in the summer of 1908, all of which recovered, were set bolt upright in bed immediately after operation and given salt solution continuously, by rectum.

Symptoms.—It is not my intention, here, to discuss the symptoms following the perforation of a typhoid ulcer, nor the physical signs by which such perforation may be recognized. It will be interesting, however, to note a few points shown in this series. By all odds the most important and the most constant symptom is abdominal pain, " sudden, sharp, severe." As characteristic as its suddenness and severity is

its paroxysmal nature. In the cases under discussion this point was well shown; in no one of them was the pain constant, in three of them the patients went to sleep after the first paroxysm. One of them, a little girl of six years, went to sleep after her first complaint before the house doctor could be called and slept peacefully for three hours. Another, a nervous, almost hysterical man, slept one and a half hours between pains, and a third, a boy who filled the ward with his cries at first, slept brokenly a good part of the time between the making of the diagnosis and his transfer to the operating room. The severity of the pain, at least in these cases, made it quite evident that there was something unusual going on, though three of the cases were in children, all of whom had complained of more or less pain throughout the course of the disease. One boy, by the urgency of his complaints, had alarmed us many times, and we had come to regard him as a chronic grumbler; but when finally he did come to experience the pain attending an actual perforation, there could be no doubt that at last his suffering was real. In this short series, sudden, sharp, severe abdominal pain, coming in paroxysms, was the only constant symptom.

Signs.—In all these cases the characteristic signs of tenderness, rigidity, and spasm were present, but in varying degree. Distention was present in only one, and then was not marked. The presence or absence of movable dulness in the flanks was not noted. One sign, to which by most authorities very little importance is attached, was present in three of the four, and its absence in the fourth was fully explained on opening the abdomen; I refer to the rapid and complete disappearance of liver dulness while there was no or very slight abdominal distention. The study of this sign in the series under consideration, and in three other cases which have come under my observation, tempts me to speak strongly of its value as positive evidence, at least, of gas free in the peritoneal cavity—a condition which, arising in the course of typhoid fever, points in almost every case to the perforation of an ulcer; and even in the few cases in which the gas

does not owe its presence to a perforation, the indication for exploratory laparotomy is absolute. In three of the cases there was a rapid and absolute disappearance of liver dulness while there was no abdominal distention. In the, fourth case the liver dulness was not diminished but the diagnosis of perforation was made on other grounds. At operation in this case there was no evidence of gas escaping when the peritoneum was nicked; there were no bubbles seen when the intestine was drawn up; there was no free fluid; there was, at first sight, practically no evidence of peritonitis. Finally, however, a piece of omentum was pushed back and there occurred a rush of bubbling, yellow fluid; and a perforation in the ileum, until this covered loosely by omentum, was revealed. In this manner the persistence of liver dulness was explained.

In connection with this point I wish to refer to three cases, not of this series, which came under my observation during my residence at the Union Protestant Infirmary:

(I) A case of a woman with typhoid fever in whom a perforation was suspected on account of pain, tenderness, rigidity, and extreme abdominal distention. Notwithstanding a marked distention of the abdominal walls, there still remained, on percussion, about one and a half inches of liver dulness. A laparotomy was done, no sign of perforation was found, and an uneventful recovery ensued. (II) A typhoid fever patient, complaining of some slight general abdominal pain, who on examination showed no signs definitely pointing to perforation, but with a non-distended abdomen there was complete disappearance of liver dulness. Operation disclosed no perforation (nor at autopsy did closest search of gut from rectum to stomach reveal any); but as the peritoneum was nicked there was a stream of escaping gas, which was plainly felt in the face of the operator. In the right iliac fossa there was a collection of pus; the cæcum and lower part of the ileum was thickened, red, and covered with fibrinous exudate. The appendix and gall-bladder were normal. There probably had been a peritonitis set up through the almost gangrenous walls of the cæcum and ileum, possibly through some perforation too small to be evident to the naked eye. In this case the deter-

mining factor in the question of operation was the absence of liver dulness with a non-distended abdomen, no other signs being definite enough to signify the necessity for surgical interference. (III) A case seen several years ago, brought in with a diagnosis of typhoid fever. There was a rapid disappearance of liver dulness followed by an extreme distention of the abdominal walls; and though the patient was perfectly conscious, he complained of no pain, nor could we at any time elicit any tenderness nor make out any spasm or rigidity of the abdominal walls. Death occurred in a few days; and when the balloon-shaped abdomen was opened at autopsy, there was an outrush of gas and a complete collapse of the walls. The intestines were found absolutely collapsed, lying against the posterior wall of the abdomen, bathed in pus. A perforation admitting the thumb was found at the junction of the cæcum and ileum. In this last case the belief that the obliteration of liver dulness with a *distended* abdomen was of no diagnostic importance prevented an exploratory incision.

The evidence of these cases seems to me to show: (1) in a *scaphoid or non-distended abdomen* the obliteration of liver dulness is extremely suggestive of free gas in the peritoneal cavity; (2) in a *distended abdomen* it is a sign which is extremely suspicious; (3) the *non*-disappearance of liver dulness in an abdomen even when enormously distended gives good ground (unless other signs are very definite) for the belief that the intestinal tract is not the seat of a perforation.

In order to avoid repetition it will be better at this point to indicate the routine treatment of the cases of this series, before perforation, and also give in some detail the postoperative treatment.

Treatment Before Operation.—Each case of suspected typhoid was isolated on admission. The temperature, pulse, and respiration were observed and noted every three hours. The diet consisted of the albumin of two eggs in four ounces of water, slightly flavored with orange or lemon juice, alternating every three hours with four ounces of milk to which was added two ounces of lime-water. Every three hours, while temperature was 102.5° F. or over, a sponge bath with water ranging from 80° F. to 90° F., lasting twenty minutes,

was given. No cathartics were used, but every second day, if necessary, an enema of 500 c.c. of soap suds was administered. Water was given freely as desired, and if need be was forced upon the patient. During the night, unless the temperature was running very high, the patient was allowed to sleep for one period of six hours without being disturbed for temperature taking or nourishment. In the case of children these same measures were carried out with slight variations, the diet being changed so that there was the albumin of one egg in a nourishment instead of two, and the sponge bath lasting for fifteen minutes instead of twenty.

Postoperative Treatment.—The general course of treatment after operation, allowing, of course, for a few unavoidable minor differences, was the same in the four cases. In the first place the patient on returning to bed from the operating room was placed as nearly bolt upright as was compatible with comfort and strength. In all these cases the patients were able to maintain the upright position more consistently than is the rule, and in no one of them were any untoward effects observed. This position was maintained uninterruptedly in all for at least four days, and in two instances the patients, seeming more comfortable in this position, were allowed to sit bolt upright for a week.

As soon as the patient had been placed in an upright posture the continuous administration of salt solution per rectum was begun. The apparatus used was one devised by myself for the purpose. It consisted of a metal frame holding a glass infusion flask and a glass funnel. The salt solution, controlled by a stopcock, was allowed to flow, one drop at a time at a fixed rate, from the flask into the glass funnel. By means of the stopcock the rate of flow could be regulated with a considerable degree of exactness. From the funnel the salt solution was conducted to the rectum through a long rubber tube terminating in a very fine rubber catheter. The salt solution was kept at the proper temperature by passing the conducting tube between two hot-water bags laid on a stand beside the bed. By means of this apparatus the majority of

patients can be given from two to six litres of salt solution per day for a week, without causing them any inconvenience, and with the loss of very little salt solution.

The drainage from the wound was profuse at the start, and at first resembled the fluid found in the peritoneal cavity at operation; but the character changed in from twelve to thirty-six hours so that finally the drainage was much less in amount and perfectly clear, hardly staining the dressings. In one case where a rubber tube was used to drain the pelvis the fluid flowing therefrom by the end of the second day could not be distinguished from the clear salt solution being introduced into the rectum. As long as the drainage was profuse the dressings were changed every four to six hours; but as it became less in amount, the dressings were changed at much longer intervals. The drains themselves were removed just as soon as it was thought their purpose had been fulfilled. When there were two drains, one of them at least was removed at the end of twenty-four hours. If the patient's condition demanded stimulation, strong, black coffee, first filtered, was mixed with the salt solution in the proportion of 400 c.c. of coffee to 600 c.c. of salt solution, and this mixture given for twelve hours at a time. In one case in which the continuous rectal administration of fluid was not successful, salt solution and coffee were given in smaller amounts every three or four hours. As soon as the patient was conscious,[1] fluid was given by mouth in small quantities, rapidly increasing to full liquid diet. As soon as the temperature became normal the patient was given soft-boiled eggs and the diet then rapidly increased until solid food was taken.

These patients were fed a little more rapidly than was our custom in the feeding of typhoid-fever patients, a quick return to normal body-weight and strength being especially desired.

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[1] In practically none of the cases of peritonitis that I have seen treated by the Fowler-Murphy method at the Union Protestant Infirmary and elsewhere has there been any postoperative nausea while the patient was in the upright position.

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REPORT OF CASES.

CASE I.—L. R.; female; white; aged 8½ years. This patient was admitted to the hospital on July 15, 1908, in what was probably her third week of typhoid fever. She showed a pretty severe type of the disease, being irrational part of the time. · On July 17 and 18 there was slight bleeding from the nose. On July 19 patient had a small hemorrhage from the bowel. Immediately all nourishment was discontinued, and water restricted to two drachms every two hours. Small doses of paregoric were given, and large doses of calcium lactate. The patient was not allowed to be turned; and ice packs, given with the patient flat on her back, were substituted for baths. On July 21, forty-eight hours after the hemorrhage was observed, there having been no other signs of bleeding, water by mouth was allowed. At 12.45 P.M. of that day the patient complained of severe abdominal pain chiefly on left side about the level of the umbilicus. On examination, one hour later, the abdomen appeared slightly full but not distended; was held rigidly everywhere; was very tender wherever touched; and the liver dulness, heretofore extending an inch below the costal margin, entirely disappeared; leucocytes had risen from 5000 to 10,000. The diagnosis of perforation was made, but on account of difficulty in ·establishing communication with the family, a delay of four hours occurred before the operation could be performed. At 2.30 P.M. the patient had small, brown, fluid stool. At 2.45 P.M. she vomited a large amount of yellowish fluid. The pulse up to noon had averaged about 100; but from the time the patient first complained of pain it rose rapidly to 122 then to 128. The temperature at 12 M. was 100.6° F. At 3.00 P.M. it was 103.9° F. Respirations remained unchanged. At 4.45 P.M., four hours after the patient had first complained, she was taken to the operating room.

Operation.—Anæsthetic: ether. Time of operation: twenty-five minutes. Low right rectus incision. Abdomen found full of clear yellow fluid without odor. Cæcum located; ileum followed up; perforation admitting a lead-pencil found ten inches from ileocæcal valve; perforation closed by purse-string suture of fine black silk, reinforced by two mattress and two Lembert sutures of the same material. Two large cigarette drains were laid through lower angle of incision to bottom of pelvis. No drain laid to site of perforation. Wound closed with catgut.

Patient was returned to bed; placed in upright position; continuous salt solution per rectum was started. The day following the operation the patient was allowed water in small quantities; dressings were changed frequently, well soaked. By the third day the drainage was clear but still large in amount. On fourth day patient was taken down from the upright position, and as the drainage had become much less in amount, one drain was removed from pelvis, second drain being removed day following. Patient's bowels were moving frequently, the salt solution acting as a low enema, and on the fifth day the administration of salt solution per rectum was stopped. Patient's condition after operation good; very little pain; no distention; pulse falling gradually; temperature running irregularly—at no time over 102.6° F. By July 27, one week after operation, patient was taking same diet as before operation. Sponge baths were resumed and the course of the disease was from that time on a typical typhoid convalescence. Patient was discharged on Sept. 16, temperature having been normal for almost a month; abdominal wound entirely healed.

An interesting point in this case was the fact that on account of slight hemorrhage on July 19, the patient had received nothing by mouth but water in small quantities for forty-eight hours prior to perforation. The early age of this patient (8½ years) is also of interest. It may be worthy of note that this patient had been ill at home for three or four weeks before coming to the hospital, and during this time had probably eaten without restriction.

CASE II.—H. E.; male; white; aged 38 years. Admitted to the hospital Aug. 18, with typhoid fever. Course of disease uneventful except for severe cough which bothered patient considerably. Aug. 24, 3.00 A.M., patient expelled a great deal of flatus. At 5.30 A.M. he received an enema, 500 c.c. of soap suds, which was expelled with a great deal of flatus and a large fluid stool consisting for the most part of dark blood. From that time until noon patient was very comfortable. At noon he began to complain of sharp pain in lower abdomen. Abdomen was examined and found flat; liver dulness normal; tenderness was elicited only on deep pressure above symphysis and in inguinal regions. The pain was of the same character as that usually seen with a distended bladder. The character of the pain, its situation, the negative result of abdominal examination, and the fact that the patient, who up to this time had been voiding large

amounts at intervals of thirty minutes, had not voided at all for one and a half hours, made it seem probable that the whole disturbance might be due to a distended bladder, though no bladder tumor could be made out. Hot-water bag was applied to lower abdomen and patient immediately went to sleep. One and a half hours later patient awoke and complained of abdominal pain of the same character as before. As he had not voided for four hours, he was catheterized, 300 c.c. of urine being obtained. He immediately became comfortable and remained quiet for one and a half hours. At the end of that time he complained again of pain as before, but examination was again negative. Patient was very much frightened, complained of tenderness wherever touched, all tenderness, however, disappearing whenever he regained his composure. At 6.00 P.M. patient had become much quieter and a much more satisfactory examination could be carried out. At this time tenderness could be made out over whole lower abdomen on light pressure. Abdomen was not at all distended, its walls were rigid; but this point was of no assistance as patient had persistently held his abdominal walls rigidly ever since admission. The liver dulness, however, had entirely disappeared. Pulse was fourteen beats higher than it had been for two days; temperature 103.5° F., which was slightly higher than it had been for several days past. On examination of the chest there were practically no breath sounds to be heard on left side. Percussion note was normal; leucocytes were 7500 in the A.M., the same in the P.M. Diagnosis of perforation was made, the absence of liver dulness with an abdomen not at all distended pointing definitely to the presence of free gas in the peritoneal cavity.

As soon as the consent of the patient's wife could be obtained, patient was taken to the operating room, eight hours after the first symptom of perforation had been observed.

Operation.—Anæsthetic: ether. Time of operation: forty minutes. Low right rectus incision. Peritoneum incised, allowing escape of yellow fluid and some gas. Cæcum located and ileum followed up from that point. About one foot above the cæcum were found four perforations; the first one oozing, the second large enough to admit a thumb, and freely draining intestinal contents. The two perforations above this one were both oozing yellow fluid and gas. The portion of gut containing perforations measured about eight inches. The peritoneal cavity was

full of cloudy, brownish fluid and fecal material; the intestines everywhere red and injected. The three small perforations were closed with purse-string sutures of fine black silk, reinforced by mattress sutures of the same material. It was impossible to close the largest perforation because its closure would have encroached too markedly on the lumen of the gut. The intestine at the site of this perforation was drawn into the wound and packed around with iodoform gauze. The edges of the perforation were then sutured to the edges of the parietal peritoneum, the sutures passing through the gauze packing. A very small iodoform drain, reaching to the perforations situated above, was laid in the lower angle of the wound. A suprapubic incision was now made in the mid-line and through it two large cigarette drains and one rubber tube were laid to the bottom of the pelvis.

Patient returned to ward greatly shocked; was put to bed in the upright position; and the continuous administration of salt solution by rectum begun. Enterostomy was draining freely and as soon as patient recovered sufficiently, he was allowed full liquid diet. His condition for thirty-six hours after operation was extremely grave, but improved progressively on no other stimulation than salt solution and coffee per rectum. Two days after operation respiratory distress became marked, the frequency varying from twenty-eight to thirty-six per minute. Examination of chest showed a tympanitic note throughout left side with an entire absence of breath sounds. Cough was constant and expectoration free. When patient left the hospital, several months later, the left side of chest was still tympanitic and no breath sounds could be heard except at extreme upper portions; but this condition seemed not to embarrass the patient in the least. By the end of the first week condition had improved very much. All the original drains had been removed, and, except from the enterostomy itself, there was but little drainage of any sort.

In this case salt solution and coffee after the third day were administered in small quantities at intervals of three hours, the patient not having been able, after the third day, to retain the fluid when given continuously. Owing to the excoriation of the skin by the drainage from the enterostomy, the patient was placed in a continuous tub on the twelfth day and kept there for two weeks. Temperature was normal from the time he was placed in the tub. Several weeks later there was some rise of temperature

due to numerous large abscesses over back and buttocks, but aside from this, patient's convalescence was uninterrupted. Three weeks after operation patient was taking solid food. Two months after perforation abdominal wounds had healed with the exception of a small fecal fistula at the site of enterostomy. Nov. 28, at a second operation, about six inches of gut were excised and a lateral anastomosis was done. Patient made uninterrupted recovery and went home on Jan. 4, 140 days after admission.

In this case we are confronted by the question as to the method of procedure in dealing with a perforation which cannot be closed, either on account of the friable condition of the edges or on account of its large size. The gut wall around the opening in this case was extremely friable; but even had it held, the lumen of the gut would have been so narrowed that obstruction would have been inevitable. The ideal method, and that usually advised, would be, then and there, to excise a portion of gut and to make an anastomosis. It seemed, however, in view of the grave condition of the patient and in view of the presence of a fierce general peritonitis, that the establishment of an enterostomy, while less desirable from many points of view than the procedure above referred to, was here the operation to be chosen.

CASE III.—P. H.; female; aged 6 years. Patient admitted to the hospital with typhoid fever Aug. 21, 1908. Disease ran a typical course for a week after admission. Aug. 29, eight days after admission, 1.30 A.M., patient awoke complaining of pain in abdomen, but immediately went to sleep again. She was, however, awakened a few minutes later during the course of an abdominal examination. At this time there was no distention of abdomen, liver dulness reached costal margin. There was slight tenderness and slight resistance to deep palpation on right side. Leucocytes were 13,500 (12,000 two days previously). On conclusion of examination patient went to sleep and slept unbrokenly for three hours. At the end of this time she again awoke crying with pain in both sides of abdomen. Second examination showed abdomen to be slightly fuller, though not markedly distended. There was general tenderness on pressure, especially on the right side, where there was also definite rigidity. Liver dulness was not diminished; leucocytes 14,000. Diagnosis of perforation was made and as soon as the consent of the family could be obtained patient was taken to operating room, seven hours after the second attack of pain.

Operation.—Anæsthetic: ether. Time of operation: thirty utes. Low right rectus incision; peritoneum incised; omen- .ttum presenting in wound appeared red and injected. There was, however, no free fluid seen, and no evidence of gas escaping from the intestine. On pushing back the omentum there was noticed the escape of bubbling, yellowish fluid. Cæcum was located, ileum followed up, and small perforation leaking intestinal contents found about one foot above cæcum. Perforation closed with purse-string suture of fine black silk, reinforced by mattress sutures of the same material. Two cigarette drains were laid to the bottom of the pelvis through the lower angle of the incision. One small strip of iodoform gauze was placed in the direction of the perforation. Incision closed with catgut. Patient was put to bed in the upright position. Continuous administration of salt solution per rectum was started. Liquid diet allowed on recovering consciousness. Condition from the first improved rapidly; temperature two weeks after operation dropped to normal and stayed there. About one week after operation the perforation apparently reopened, at least in part, and for a week there was a slight fecal dischaiɡ꙳ This, however, ceased spontaneously, and recovery was otherwise uneventful. Patient left the hospital on the fifty-fifth day, sinus having been closed for several weeks.

It is interesting to note that in this case the liver dulness remained undiminished in spite of perforation in the intestine. This, however, was explained at operation, when it was found that the perforation was loosely covered by omentum. This case showed better than any other the intermittent or paroxysmal character of the pain as seen after perforation of a typhoid ulcer, the patient having slept unbrokenly for three hours after her first complaint. Perforation in typhoid fever at this age (six years) is rare.

In following out this line of treatment, there was not noted a single sign or symptom indicative of a bad effect on the course of the typhoid fever. On the other hand there was a very rapid subsidence of the peritonitis and a more rapid return to normal temperature and the stage of convalescence than was observed in the majority of our cases of typhoid uncomplicated by perforation.

CASE IV.—T. H.; male; white; aged 12 years. This case came in with typhoid fever in about the second week of the disease. Course of the disease after admission was moderately severe. Patient complained frequently of abdominal pain after taking nourishment. There was nothing, however, abnormal made out any time on examination and most of the complaints were, after a time, put down to a grumbling disposition.

On Sept. 6, after having been comfortable all morning, sleeping part of the time, the patient awoke at 1.00 P.M., complaining of intense abdominal pain. He was seen immediately and his complaints were more marked than those of any of the cases reported thus far. Pulse had not risen; respirations, however, were thirty. On account of the restlessness of the patient it was impossible to have a temperature taken. Abdomen was distended and held absolutely rigid all through. Liver dulness was completely obliterated. A half-hour after the first complaint, pulse had risen sixteen beats. An hour after patient had begun to complain, the pain apparently abated and patient went to sleep. Patient vomited once before operation. As soon as consent could be gained, patient was taken to the operating room, three hours after pain was first complained of.

Operation.—Anæsthetic: ether. Time of operation: thirty minutes. Right rectus incision at the level of umbilicus. As the peritoneum was incised, a straw-colored fluid gushed out to the height of six or seven inches. Peritoneal cavity was found full of fluid with some solid particles of fecal material. Intestines were everywhere red and injected. Cæcum was located, ileum followed up, and a large perforation found about one foot above cæcum. This perforation was closed with difficulty, as it was situated in the centre of a large ulcerated area and the edges were very friable. Closure was done by purse-string suture of fine black silk, reinforced by several mattress sutures of the same material. This, it was found, had constricted to some extent the lumen of the gut; but the tip of one's finger could be passed through. Two cigarette drains with a rubber tube between them were laid through lower angle of incision to bottom of pelvis. One small strip of iodoform gauze was laid in the direction of the perforation. Closure with catgut.

Patient was put back to bed in the upright position and given continuous salt solution per rectum. Condition of patient after

operation improved—pain, tenderness, and rigidity quickly disappearing. Temperature remained up, but pulse came down to same rate as before operation.

Liquid nourishment was started. Drainage from wound was profuse and drains were started early. On the sixth day after operation abdomen became very much distended; no movement of bowels could be induced; temperature jumped up to 106°, pulse to 180. Abdominal distention was so great that a loop of distended gut presented alongside of the drains in lower angle of incision. An intestinal obstruction was diagnosed (this having been feared at time of operation on account of encroachment of lumen of gut by closure of perforation); an opening was made with a cautery in the wall of the distended loop of gut presenting in wound, and the abdominal condition was promptly relieved.

Patient's general condition improved slowly for a few days, after which improvement was more rapid. There was, however, one other attack of obstruction on the thirty-fourth day after operation, which was relieved by enemata given through enterostomy wound, accompanied by vigorous abdominal massage. Aside from this the convalescence was uninterrupted, though somewhat delayed by the presence of a deep bed-sore occupying the sacral region. The temperature of patient had not reached normal until the forty-sixth day after operation. He was discharged on the sixty-third day with a small fecal fistula. Two weeks later the patient was seen, and by that time the fistula had closed entirely.

This patient was a brother of the little girl whose case was reported immediately before this (Case III). There were in the hospital at the same time four members of this family with typhoid fever. Two of them perforated, were operated upon, and recovered. A third was referred to above —a case of general peritonitis with no discoverable perforation. He was operated on at the same time as Case IV, and died the day following. The fourth member of the family had an uneventful attack of typhoid and recovered.

SPONTANEOUS RUPTURE OF THE SPLEEN IN THE COURSE OF TYPHOID FEVER.*

BY ROBERT C. BRYAN, M.D.,

OF RICHMOND, VA.,

Professor of Descriptive Anatomy and Genito-urinary Surgery in the University College of Medicine; Visiting Surgeon to Virginia Hospital.

THAT enlargement of the spleen to various degrees is constantly present in typhoid fever is well known clinically and emphasized by all text-books on internal medicine; but that the tension from within may be so great as spontaneously to overcome the thinned-out capsule and peritoneal investment is mentioned by comparatively few authors even as a possible complication of enteric fever. In looking over all available literature the writer finds that fourteen text-books on internal medicine do not mention spontaneous rupture of the spleen in the course of typhoid fever as even a possible complication. Four other text-books, however, state that it is possible and may occur.

OSLER ("Practice of Medicine," 6th edition) says, "The spleen is invariably enlarged, rupture may occur spontaneously or as the result of injury. In the Münich autopsies, 2000 in number, there were 5 instances of rupture of the spleen, one of these was caused by abscess." A letter from Dr. Osler to the writer, December 6, 1908, says, "There was no rupture of the spleen in our Johns Hopkins Hospital series. . . . I have often wondered why the organ did not rupture, I have seen it like a bag of molasses."

HERRICK[20] of Chicago says, "Spontaneous rupture of the spleen in typhoid fever seems to be extremely rare. No case has come under my notice nor do I remember to have heard of one in Chicago, where typhoid fever is not at all uncommon."

STENGEL[34] states his experience as practically that of Herrick's.

ANDERS ("Practice of Medicine") says, "Kern has searched the literature and found only 9 cases of abscesses. In rare cases, either spontaneously or as the result of injury, the spleen may rupture; and the records of 2000 post-mortem typhoids at the Münich Pathologic Institute furnish 5 cases."

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* Read before the Tri-State Medical Society of Virginia and the two Carolinas, at its annual meeting in Charleston, S. C., February 17, 1909:

BUTLER ("Diagnostics of Internal Medicine") believes that "in the excessive degree of hyperæmia sometimes present in typhoid, malaria, and other fevers, spontaneous rupture may occur; traumatism is a more common cause."

The following series of reported cases of spontaneous rupture of the spleen in the course of typhoid fever have been collected * for the writer and are believed to be complete to the present time.

CASE I.—AASER[1] reports a case of rupture of the spleen following typhoid fever. Man, aged 20 years. Attack of typhoid fever running a two-weeks' course. Admitted to hospital and died one-half hour later. Autopsy, rupture of the spleen so great that a portion of the organ was almost severed from the rest.

CASE II.—COLLIN[2] reports a case of rupture of the spleen in enteric fever. Man, aged 19 years. Chronic diarrhœa, abscess of right lung, general peritonitis. Death. Autopsy. All the viscera mutually adherent, false membranes mixed with blood. Spleen ruptured in three places; two were superficial, but the other long and situated at the posterior border of the organ. There was a depression of 6 cm. Spleen weighed 225 grammes. The parenchyma was brownish-black in color.

CASE III.—CRAIG[3] reports a case of rupture of the spleen. A soldier, aged 23 years. Illness began eight days before admission to hospital. Diagnosed on transport as intermittent malarial fever. Admitted. Headache, diarrhœa, and tympanitic abdomen. Blood negative for malaria. Typical course of typhoid fever. Great pain in left hypochondrium. Collapse. Death. Autopsy. Coils of intestines mutually adherent, gas, purulent exudate, appendix inflamed greatly. Spleen had large laceration through the capsule, 3 cm. in length; the organ measured 20 by 11 cm. dark reddish-purple. Upper section showed dark mahogany red. Malpighian corpuscles indistinct, much congested; rupture went into the substance of the organ. Typhoid lesions in other organs.

CASE IV.—DARWIN[4] reports a case of rupture of the spleen in fever (kind not stated). Man, aged (?); soldier in Indian Infantry. High fever and great pain in abdomen. Diarrhœa, fæces pale yellow; abdomen somewhat hard and resistent (evidently typhoid). Death. Autopsy, seven hours after death. Green fluid escaped from the nose. Stomach distended, also intestines, coils adherent. Spleen adherent to abdominal walls, much enlarged. Capsule ruptured. Dark coagulating blood protruding.

CASE V.—ERICHSEN[5] reports a case of spontaneous rupture of the spleen in typhoid fever. Patient convalescent, when he suddenly fell backward and was dead. Autopsy. The spleen had a long rupture and

* By Dr. Carl H. Von Klein of Chicago and his staff of foreign correspondents.

the wrinkled capsule surrounded a confluent, livid-red parenchyma, in which there was no trace of the normal tissue. The rupture was near the hilum and was from 3 to 4 inches in length. Liver much enlarged.

CASE VI.—LIDELL [6] reports a case of spontaneous rupture of the spleen in typhoid fever. Woman, aged 25 years. Admitted to hospital on Ward's Island (1849). " Ship fever." Had been ill three days. Usual symptoms of sudden internal hemorrhage. Death in one hour. Autopsy sixty-six hours after death. Peritoneal cavity contained 90 ounces of extravasated blood, 40 ounces of it firmly coagulated. Came from ruptured spleen. Peritoneal coat torn through. Splenic parenchyma soft and chocolate color. No injury and the rupture must have been spontaneous.

CASE VII.—NÜCKEL.[7] Man, aged 25 years. Fever with pain in the lower abdomen. Death. Autopsy forty-eight hours after death. Blood extravasation from the left hypochondrium to the entrance of the small pelvis. Was coagulated in large clots. Spleen ruptured in an angle-shaped tear. Spleen 5 by 4 inches. The surrounding fasciæ were so degenerated that they tore when touched.

CASE VIII.—PETERSON.[8] Man, aged 36 years. Soldier five days ill with typhoid fever. Great pain in lower abdomen. Death. Autopsy. Lungs œdematous, peritoneum injected. Spleen 17 by 8 by 4 cm. Yellow infarct size of hazelnut, convex surface ruptured.

CASE IX.—PETERSON.[8] Man, aged 21 years; attack of intermittent typhoid fever. Spleen region sensitive. Cyanosis. Death. Autopsy. Spleen much enlarged, particularly in longitude. Ruptured at both ends radiating to the capsule.

CASE X.—PETERSON.[8] Man, cigar-maker, great perspiration, attack of fever. Great pain in lower abdomen. Exudate in abdominal cavity. Death. Autopsy. Heart, liver, and kidneys showed parenchymatous degeneration; 1½ lbs. of pus in abdominal cavity. Spleen 16 by 11 by 5 cm. Ruptured on lateral end.

CASE XI.—PETERSON.[8] Man, aged 26 years; 17 days in hospital, typhoid fever. Vomiting, collapse, death. Autopsy. Heart lax and anæmic. Thick dark-brown blood in abdominal cavity. Peritoneum slightly injected. Intestinal walls suffused. Omentum thick. Spleen 19 by 13 by 3 cm., attached to the ventricular fundus. Rupture on lower lateral end.

CASE XII.—PETERSON.[8] Woman, aged 39 years; factory worker. Fever, delirium, vomiting, icterus, and death. Autopsy. Lungs œdematous and left pleura somewhat fibrinous. Spleen 16 by 11 by 6 cm., a row of infarcts seen through the capsule. Rupture of stomach portion.

CASE XIII.—PETERSON.[8] Boy, aged 11 years; factory worker. Intermittent typhoid. Death. Rupture of the spleen in part in the stomach.

CASE XIV.—PETERSON.[8] Man, aged 28 years; severe case of typhoid fever, death. Autopsy. Concretion of pus size of hen's egg in upper lobe of left lung. Heart degenerated. Spleen 19 by 14 by 5 cm., three ruptures on forward border with irregular broken edges.

CASE XV.—SANTI [9] reports a case of spontaneous rupture of the spleen in typhus. Patient, aged 20 years, complained of pain in the left hypochondriac region, particularly near the spleen. Left leg and foot swollen,

owing no doubt to a venous thrombus. Typhus diarrhœa, condition serious. Entrance to hospital, fifty days later seemed to be improved. Temperature 38° C. Later felt violent pains in left side, involving the entire abdomen. Death in a few hours. Autopsy. Spleen much enlarged, jelly-like in substance; exudation of purulent matter into peritoneum. Recent discolorations. Two round ulcers in the abdomen; recent discoloration in the right kidney. Rupture of the splenic capsule no doubt due to recent and prior embolism.

CASE XVI.—SWAVING.[16] Spontaneous rupture of the spleen. Man, aged 35 years, Chinese; malignant typhoid. Enlarged spleen and liver. Ran a course of four days. Death. Autopsy. Thin, serous, bloody fluid in the abdominal cavity. Large black lump of blood covered entire spleen and part of the stomach. Liver hypertrophied. Spleen 20 by 10 by 7, weight 6 lbs. Diagnosed rupture, 2 inches in length and 1 inch deep. Pulp in the tear, a red-brown mass, vessels empty. Spleen solid substance. All the other organs (except liver and spleen) were empty of blood.

CASE XVII.—HEIMANN[20] reports a case in which the extension of the spleen was so remarkable that the organ ruptured and the jelly-like substance emptied into the abdominal cavity. It was full of whitish-yellow spots.

CASE XVIII.—WITTMANN[17] reports a case of rupture of the spleen in typhoid fever. Boy, aged 10 years, healthy, well-built child. Attack of typhoid fever. Skin hot and dry. Rapid respiration and cough. Strong pulse, 120. The splenic dulness began on the lower border of the eighth rib and lapped the last false rib. Patient somnolent and half delirious, great thirst. Death. Postmortem. The stomach contained great quantity of "coffee-colored" fluid. Liver pale and gall-bladder almost empty. Spleen much enlarged; 2½ inch rupture, beginning at the spleen entrance and ending on the upper surface.

CASE XIX.—GRIESINGER[21] describes a case of rupture of the spleen in typhoid fever. Patient in delirium jumped out of the window. Death twenty-four hours later. Autopsy revealed, in addition to other injuries, a rupture of the spleen in three different places. There was a slight extravasation of blood.

CASE XX.—WEST and DUDDING[18] report a very rare case of typhoid fever complicated with spontaneous rupture of the spleen. Man, soldier, aged (?). Headache of two days. Abdomen slightly full, but not marked enlargement of spleen. Temperature rose above 103°, a few rose spots on abdomen on third day. Abdominal pain, pulse weak and rapid. Perforation suspected. Operation. Blood in lower abdomen and intestines floated upward, collapse and wound closed. Death. Necropsy. Spleen enlarged and ruptured three inches on diaphragmatic surface. Weighed 2 lbs. and 2½ ounces, capsule separated by clot. Duration of disease eight days.

CASE XXI.—CHROSTOWKI.[13] Patient, blacksmith, aged 27 years, who was sick for several days before a physician was consulted. He was delirious and when the physician arrived he found the temperature 40.3° C., pulse over 100, respiration 24 to the minute. On the second day the patient

became very delirious, desperately attempting to get out of bed. The slightest touch on the left side in the region of the spleen seemed to him the pangs of death; often signing and pointing to the region of the spleen. Temperature 39.4° C., pulse 126, respiration 40, nose and ears cold and cyanotic. The abdomen was enormously enlarged. Ice compresses were applied over the abdomen, he became thoroughly unconscious about 3 o'clock the next morning and died at 7 o'clock the same day. Post-mortem revealed the spleen to be six times the usual size, the outside being covered with thick dark blood; and when the blood was removed it revealed a vertical rupture of the spleen from 8 to 10 cm. long. The splenic artery was also torn.

CASE XXII.—CHROSTOWKI.[12] Patient, 18 years old, typhoid fever; was six days in bed before going to the hospital. Temperature 40.5° C., respiration 24. He continued in the same condition up to the tenth day at the hospital, which was considered good, notwithstanding that he lost a great deal of strength. About the sixteenth day in the hospital he became delirious, the temperature being 38° C. in the morning to 40.4° C., pulse 126. Next day the temperature fell to 37.6° C., pulse 100, respiration 28. Patient seemed to feel better, but on the eighteenth day he died at 6 o'clock. Postmortem revealed a rupture of the spleen 3 cm. long. The spleen was found considerably enlarged, was surrounded with thick coagulated blood, and the splenic artery torn. The spleen was removed, and upon examination internally it was found that the pulp of the spleen was also ruptured and filled with thick coagulated blood.

CASE XXIII.—DELAFIELD.[19] Typhoid fever, rupture of spleen. Boy, 8 years old; two weeks ago caught cold; seized with cough, fever, coffee-ground sputa, a little pain in the right side of the chest. Worse every afternoon. No diarrhœa or epistaxis. Tongue clean; pulse 100, temperature 99¾°; bowels regular; urine 1010, no albumin. Coarse râles over both lungs.

> October   29, pulse 100–112, temperature 99¾°–102¼°.
> October   30, pulse 114–122, temperature 100° –103½°.
> October   31, pulse 104,   temperature 100¼°.
> November 1, pulse 96–120, temperature 99° – 98½.
> November 2, pulse 98–120, temperature 99° – 98½°.
> November 3, has been improving, to-day sat up.
> November 7, complains of weakness, stays in bed.
> November 10, suddenly much worse.
>   2 P.M., pulse 145, temperature 104¼°.
>   8 P.M., pulse 144, temperature 105½°.

November 11, 2.30 A.M., was found in the hall dying. Died 3 A.M. *Autopsy*, November 11, 2.30 P.M.—Brain, slight increase of serum beneath; heart, normal, not softened; lungs, moderate bronchitis; liver, normal.

Spleen, 14 ounces, a very large rupture extending all around it at its middle. In the peritoneal cavity a large amount of blood. Large intestine normal. Along entire length of ileum, solitary and agminated glands very

much swollen and a very few of them ulcerated. Small nodules in mucous membrane. Mesenteric glands very much swollen.

CASE XXIV.—AFANASSJEFF[18] relates a case of rupture of the spleen in typhoid fever. Patient a medical student, aged 24, weighing 148½ pounds. Diagnosed at first some form of intermittent fever. He complained of great deal of pain in left side with a temperature of 40° C. The high temperature indicated a case of infection and was pronounced typhoid fever. The patient constantly complained of severe pain on the left side and of being unable to lie on that side. The spleen could be felt to enlarge daily. Quinine was administered for twenty-three days, when it was noticed that the enlargement of the spleen extended below the ribs more than three inches wide, very painful to the touch, showing that suppuration had taken place. Dr. Pineck, the consulting physician, introduced in several places an exploring needle, between the lower ribs in the axillary line, but no pus was obtainable. He later for the second time introduced an exploring needle with some success in bringing pus, which was passed under the microscope and found to contain suppurative matter. An incision was made below the lower rib in the axillary line of the extended part, bringing forth a large volume of pus mixed with blood. A digital examination was made, the finger found its way to rupture of the spleen. The spleen was treated accordingly, and owing to the vitality of the patient he recovered.

To these I now add another case, as follows:

CASE XXV.—BRYAN. Mr. L. M. S., aged 31, married, blacksmith, Dry Creek, W. Va., having always enjoyed good health, Saturday, October 31, 1908, came home from work, stating that he had felt badly all the week. Dr. O. F. Richter was called in, temperature at 3 P.M. was $103^4/_5°$, patient complained of headache and nose bleed. Sunday, November 1, temperature at 11 A.M. was $103^3/_5°$; hospital recommended. Monday, November 2, temperature at 6 A.M., $103^1/_5°$; patient sent to the Virginia Hospital, Richmond, Va., 200 miles distant.

November 2, 5 P.M. on admission, a well-developed muscular man, height 5 ft. 10 in., weight 175. For a week past has had fever; complains now of slight headache and a moderate pain in the left side under the ribs. No significance was attached to this pain at the time, it being supposed to be muscular or from some strain in transportation. The tongue was coated and furred, cheeks flushed, abdomen moderately distended and tympanitic, the spleen not felt, some few rose spots.

The course of the patient's temperature, although very high during the succeeding two weeks, responded readily to the alcohol

rub. In lucid intervals, at times he complained of an indefinite pain in the abdomen, while at other times it was referred to the left thigh and knee. When questioned more closely the true location and severity could not be determined. He was constantly under the attendance of a day and night nurse. The alcohol rubs were given on woollen blankets upon which he was gently rolled, every four hours, the temperature exceeding 103° F. The diazo reaction was positive on each examination. The patient was never violent nor out of bed, nor assumed the sitting posture. No physical examination was made of the spleen other than daily inspection and superficial palpations of the abdomen. The nourishment was liquid. The bowels moved daily. The temperature was taken by rectum except when otherwise stated.

SUNDAY, NOVEMBER 14.

	Temperature.	Pulse.	Respiration.
4 A.M.	$104\frac{2}{5}°$	116 ·	22
Rectal (after alcohol rub)	$103\frac{1}{5}°$	88	20
8 A.M.	$104\frac{1}{5}°$	96	26
Rectal (after alcohol rub)	$102\frac{3}{5}°$	92	20
12	$104\frac{3}{5}°$	96	28
Rectal (after alcohol rub)	$104\frac{1}{5}°$	92	28
4 P.M.	$105°$	110	30
Rectal (after alcohol rub)	$104\frac{1}{5}°$	92	28
8 P.M.	$105\frac{4}{5}°$	136	28
Rectal (after alcohol rub)	$104\frac{4}{5}°$	130	30

The writer was called and at 8.30 P.M. found the temperature, by axilla, 106°, pulse 138, respiration 36.

The face was pinched, nose and extremities cold, moderate dyspnœa. The pulse was rapid, weak, running, but regular. The belly hard, resistant, and tympanitic, but not distended; knees extended. There was no absence of the liver dulness. Diagnosis: Perforation and hemorrhage.

The hyperpyrexia could not be accounted for. The patient was carried immediately to the operating room; and under ethyl-chloride and ether narcosis, which was intermittently administered, an incision 15 cm. in length along the outer border of the right rectus muscle was made. The intestines were turned out on hot pads and a systematic search made for the perforation. None was found. Moderately thickened Peyer's patches were evident here and there. Enlargement of some mesenteric glands

Ruptured spleen, size 7 x 3⅞ inches.   Site of rupture, inferior pole.   I. Anterior view.   II. Inner view.   III. End view.
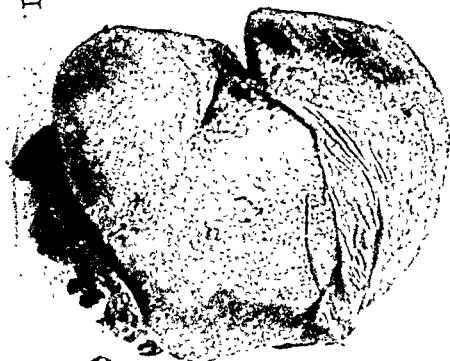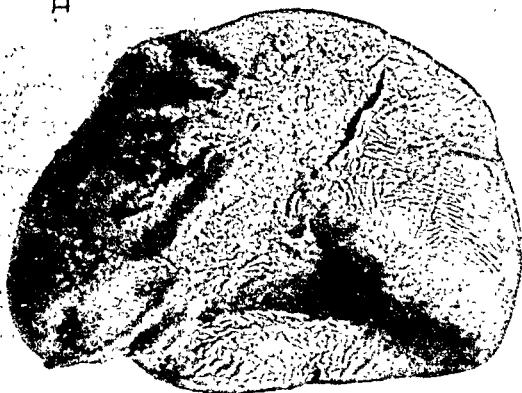
was noticed. During the progress of evisceration quantities of blood would now and then well up into the wound. A gauze sponge carried down to the pelvis was saturated with blood and a few clots. The incision was now extended further down, and the pelvis found to be filled with about 10 to 15 ounces of dark tarry blood with few coagula. This was removed but rapidly reaccumulated. Infusion into the left median basilic ordered, 30 ounces normal saline.

The peritoneum was normal. There was considerable ballooning of the sigmoid. The iliac veins were supposed to be the source of hemorrhage, but were found normal. The spleen being suggested as the possible source of the hemorrhage the operator ran his hand upward, to feel a soft, pulpy, enlarged, and movable tumor, from about which large quantities of blood, blood-clots, and splenic pulp were raked away. The incision was now rapidly carried upward and toward the middle line within 'a few cm. of the xiphoid cartilage. The spleen was turned out on the belly wall; there were no adhesions; its pedicle was clamped, transfixed and cut, and the organ removed.

Infusion of normal saline again ordered, patient taking up about 50 ounces. Blood clots, coagula, and splenic pulp were wiped away; the peritoneal cavity filled with a quart of hot saline solution; the wound rapidly brought together by through-and-through sutures of silkworm gut. Despite succeeding measures to combat the shock and loss of blood, the patient died in one hour. No autopsy was allowed. The spleen measured 18 by 9 cm. and weighed $14^2/_3$ ounces.

The rupture was at the lower pole, stellate, everted, crater-like, from which small masses of splenic pulp were dangling. The organ was soft, pliable, pulpy, of a dark blue to blackish color. The capsule had been torn across at the site of the rupture and had retracted upward anteriorly and posteriorly as high as the hilum. The normal contour and shape of the spleen were evident. It is impossible to say, in the haste of the operation, how much blood was found in the abdominal cavity, probably one quart or more.

The writer is indebted to Dr. E. G. Hopkins, pathologist of the Virginia Hospital, for the following pathological findings:

" The tear extends 16 mm. into the substance of the organ and occupies an area of 22 by 38 mm. on the surface.

" The tissue surrounding this lesion is markedly hyperæmic and presents numerous areas of extravasated blood. Considerable areas consisting of large pale, partially necrotic cells are abundant in the splenic pulp, the Malpighian bodies being practically normal. A mural thrombus was found in one of the veins. Groups of bacilli are present in the blood-vessels and scattered throughout the sections."

The following cases recorded as spontaneous ruptures of the spleen by their respective authors should also be reported. It seems most improbable, however, that a ruptured spleen in the course of typhoid would go on to recovery without operative intervention.

CASE XXVI.—KERNIG[20] reports a case of spontaneous rupture of the spleen in typhus. Man, aged (?); healthy, strong. Attack of typhus exanthematicus. Fourteen days of convalescence and then four (not lasting) feverish attacks. At each slight attack the spleen increased in size; after the last one the organ was much enlarged. Vomiting and pain low in the epigastrium; collapse; and death feared. Abdomen distended. From the arch of the ribs to the os pubis was a large swelling. No sensitiveness on pressure. Disappearance after thirteen days. Beginning of pneumonia and then recovery. Diagnosis: rupture of the spleen, possibly through an infarct.

CASE XXVII.—STEUDEL[21] reports a case of rupture (?) of the spleen in typhus fever. Man, aged 28 years. Officer, returned from East Africa. Had had malarial fever and on return had attack of typhus fever. A spleen tumor was suspected but could not be symptomically defined. Recovery. Probably a rupture of the spleen or diaphragm. In this case (a strong young man) a rupture of the diaphragm was the least likely, so undoubtedly the rupture was of the spleen.

CASE XXVIII.—HARTLE[22] reports a case of rupture of the spleen in typhus fever. Boy, aged 13 years. Attack of intermittent typhoid fever. Spleen abnormally swollen so that the border overlapped the umbilicus. It felt like an enormous bladder filled with water. Destroyed the functions of the chylopoietic viscera. Convulsions; pulse could not be felt. Abdomen had been soft and lax, but was now much distended. Spleen probably ruptured and contents escaped into abdominal cavity. Recovery.

The one instance of splenectomy reported during the course of typhoid fever is that of (Ashby[23]) Case XXIX. A case of wandering spleen in typhoid fever. Patient woman aged 22 years. Large mass in left inguinal region. Temperature

104°; pus tumor suspected. Laparotomy. Enlarged spleen wedged in pelvis. Pedicle, 8 inches long, was ligated and spleen removed. Other organs normal. Typical typhoid course. Was a malarial spleen, contracted in a malarial section of the country. Recovery.

In this instance despite the high temperature and typhoid condition an enlarged, unruptured, wandering, malarial spleen was successfully removed. A letter from Dr. Ashby to the writer, January 9, 1909, says, " The temperature chart showed a most erratic course, as her temperature would jump from 98½° to 106° and rise and fall in the most eccentric manner. The patient had atypical typhoid fever, which did not show up until after her spleen was removed. The spleen was impacted in her pelvis. She made a perfect recovery and five years after the operation she was in perfect health, had married, given birth to a child, and had gained 20 pounds in weight. I regret that I cannot give you further data."

Carstens [37] reports 122 ruptures of the spleen from hypertrophy or injury, with 83 recoveries and 39 deaths.

Rupture of the spleen in the course of malarial fever is not uncommon; many cases have been reported. It is not the writer's intention to take up the many other causes of rupture of the spleen in parturition,[35] trauma, ecchinococcus, cystic degeneration, varices,[38] hypertrophy, following epistaxis,[39] abscesses,[24] malignant overgrowths, infarct, torsion; but suffice it to say that the removal of this organ (Carstens [37]) has been accomplished 739 times to January 1, 1905, with 521 recoveries and 197 deaths. Since then there have been many splenectomies performed and the operation for leucocythemic hypertrophy with its large death rate having been abandoned, the total mortality for splenectomy, 26 per cent., would be considerably lowered.

Anatomical Location of Spleen.—The normal area of spleen dulness is ovoidal in shape, its long axis corresponding to the direction of the ribs; and is found between the lower border of the eighth rib and the eleventh intercostal space, between the mid-scapular perpendicular posteriorly and the mid-

axillary perpendicular anteriorly. The normal spleen is palpated with great difficulty, if at all, by virtue of its covered position under the costal arch.

Etiology.—Adler [25] says regarding spontaneous rupture of the spleen in typhoid fever, that it has been demonstrated that the Eberth bacillus is found most often with the exception of the intestinal tumors and in the swollen mesentery glands) in the spleen. Numerous experiments and observations, therefore, have been made with culture of the juices of the ruptured spleen to decide a difficult case of diagnosis of abdominal typhus; and certainly the most solid proof we have of this " splenic toxæmia " is the great danger to life when the spleen ruptures.

Philipowicz [26] made examinations in four cases of abdominal typhus to discover the bacillus in the spleen. The spleen was punctured with the Pravaz syringe and the juice subjected to bacteriological investigation. Typhus colonies were found in great numbers. He concluded that this is the surest method for positive diagnosis.

In the laboratory Newhauss [27] performed experiments on rabbits and mice with the juice obtained by means of a Pravaz syringe from the enlarged spleen in the course of severe typhoid, his results being identical with Koch-Eberth bacillus of typhus abdominalis.

Laveran,[28] too, reports a case of typhoid with an examination for bacillus at the autopsy. Bacteriological examination of the splenic pulp grown in gelatin gave a perfect culture of Eberth's bacillus.

Hein also demonstrated this bacillus taken from the spleen.

Pathology.—Malinin [29] says that the spleen lacks the fibrous tissue to give it a structural foundation as well as certain lymphoid or round-shaped elements. All the firmness or consistency it possesses is in the characteristic spindle-shaped splenic cells: these are capable of extraordinary contraction and are attached to the neighboring cells; this gives the spleen construction. The strong permanent kernels of the splenic tissue have a lively amæboid movement, and form a

cavity in which all the dead cells, red and white, are taken out of the circulation. These degenerate and get into the circulation as white blood-corpuscles. The spleen cells form rapidly. In intermittent fever multitudes of the blood-cells are ruined and the splenic cell-kernels take up the ruins. This obtains in typhus (abdominalis).

Lidell,[6] concerning his case of spontaneous rupture of the spleen in typhoid fever, says that the causes of the rupture seem to be several: (1) Softening of all the structures of the organ, including coats of the blood-vessels. (2) Intense congestion of the portal vein and radicles; this often comes with the early stages of petechial typhus and malarial fevers. (3) Stagnating blood distending and pressing the soft walls of the blood-vessels in splenic surface; this forces blood between splenic tissue and capsule and invested peritoneum. (4) Blood increasing compresses the parenchyma on one side and dilates the capsule and peritoneum on the other. Possibly the spleen may have been previously weakened in some unknown manner.

Heimann [10] reports an epidemic of typhus in the Military Hospital, beginning in April, 1840. The numerous deaths gave opportunity to study the changes in the spleen. In many cases it was found to be enormously distended, sometimes more than three times the natural size; then the lower end reached the border of the pelvis; the substance was much attenuated and weakened.

Zimmermann [82] believes that in cases of typhus the swelling of the spleen never fails and there is a predisposition to rupture. Spontaneous rupture is rare, but the organ is ready to be ruptured by blow or fall or sudden movement of the body. It is a question whether all so-called " spontaneous " ruptures are not in this class. The period in which the organ reaches its greatest magnitude varies greatly, from the end of the first week to eighteen days.

Mosler [15] says that where there are pathological changes in the spleen a rupture may occur spontaneously, or may be brought about by traumatic influence. Spontaneous ruptures are the consequences of an acute and very rapid swelling or

extension of the organ. Rokitansky thinks it comes oftenest in typhoid fever and in intermittent fevers. In the latter cases it occurs in the period of the chill. Death usually follows in twenty-four hours.

Cantlie [30] explains spontaneous rupture of the spleen in pernicious or intermittent fever by the softening of the tissue and the adhesion of the organ to its visceral neighbors, the weakness and immobility predisposing to rupture.

Boinet [31] attributes spontaneous rupture to the same cause.

Wilson [33] thinks it most probably that in the so-called " spontaneous rupture " the exciting cause is an action of muscular pressure while the subject is turning or moving suddenly. He does not believe that the spleen ever ruptures without this impetus, however softened and coagulated it may be.

The size to which the spleen may enlarge is not so dependent upon the degree of intoxication as upon the resistant force of its enveloping capsule, and of its properitoneal and peritoneal investments. The restraining influence of this extraperitoneal connective tissue can be but little; the cross leaves of its fibres are readily stretched and separated; the organ crowds through the separation and is now held back by the peritoneal coat alone, which eventually, being unable to withstand the increased tension, gives way and decides the physiologic instant of spontaneous rupture.

FINDINGS BY AUTOPSY OF RUPTURED SPLEEN IN TYPHOID FEVER.

Weight of spleen...	Largest, 6 lbs., Case XVI.
	Smallest, 225 Gr., Case III.
Size of spleen	Largest, 20 by 10 by 7 cm., Case XVI.
	Smallest, 5 by 4 inches, Case VII.
Length of rupture..	Longest, organ almost severed, Case I.
	Shortest, 3 cm., Case III.
Number of ruptures	Three in Cases II, XIV, XIX.
	Two in Case IX.
	One in 20 Cases.
Depth of rupture...	Greatest, 6 cm., in Case II.
	Least, 2.5 cm., in Case XVI.
Shape of rupture...	Angle-shaped in Case VII.
	Irregular edges in Case XIV.
	Crater-like in Case XXV.
	Not mentioned in remaining cases.

Site of rupture.....	At or near the middle in Cases II, V, VIII, XII, XIV, XVIII, XX, XXI, XXIII. At or near the ends in Cases IX, X, XI, XXV. Not mentioned in remaining cases.
Rupture into neighboring organs	Stomach, Case XIII.
Amount of blood in peritoneal cavity	Greatest mentioned, 90 ounces, Case VI. Least mentioned, 1 quart, Case XXV.
Condition of spleen	Not mentioned in Cases I, VII, VIII, IX, X, XI, XII, XIII, XIV, XVIII, XIX, XX, XXI, XXII, XXIII. In remaining cases described as: Brownish-black, bluish-black, purplish; mahogany, chocolate, etc., etc.; pulpy, soft, pliable, etc.
Condition of splenic vessels	Splenic artery torn, Cases XXI, XXII.

Peterson [8] thinks that the median and convex part of the spleen are most exposed to danger of rupture of the capsule. It is here that the support is greater but the channels larger.

In three out of five cases reported by Cantlie [30] the rupture was near the hilum in the shape of a star, and in other cases of Cantlie's noted in Hong Kong the rupture was in each instance behind the hilum longitudinally and as if cut with a sharp knife.

Vigla [34] states that the form of rupture is linear or round and the quantity of extravasated blood usually very great.

Fatal termination seems to be the only outcome for rupture of the spleen, regardless of its size or depth, for if hemorrhage does not exsanguinate the poison overwhelms.

SYMPTOMS.—Vigla [34] says the usual symptoms are a pain in the splenic region, distention of the abdomen, and very often vomiting, small pulse, unconsciousness, with constitutional energy to the last. Death is the outcome.

The symptoms should be divided into (1) a preruptured period and (2) the postruptured period.

1. *Preruptured Period.*—Earlier in the disease the patient complains of the pain attendant upon the stretching of the capsule and investments, which is intermittent, not constant, of short duration, and lancinating. The tumor fills to various

degrees the left flank, its edge is not sharp but rounded, and feels soft or boggy. Blood-count is insignificant. The tumor is differentiated easily from the kidney. Later the hebetude, lethargy, and typhoid state, dependent upon the degree of intoxication and not upon the size of the spleen, are sufficiently overwhelming to allow no subjective signs. Intestinal disorders and tympany should follow from the splenic colon becoming angulated. What we bear constantly in mind is a large flabby tumor with an always weakening and thinning belt.

2. *Postruptured Period.*—This may be summed up in two words: (*a*) hemorrhage; (*b*) sepsis. The loss of blood is immediate and great. The tumor, if formerly much enlarged, is now smaller, irregular in outline, or may not be felt at all; the pulse is rapid, thready, and weak; the facies pinched and cold. There is air-hunger and restlessness. The delicate, highly organized, and multiple lymphatic channels in the rapidly-absorbing peritoneal roof and walls of the abdominal room are overwhelmed by the escaping poison from the spleen; and the temperature is high, 104°–107° F.; the patient complains of slight or no pain, the belly wall is hard and tympanitic, or flat in the flanks. There is no loss of liver dulness. Rectal examination is negative. The physiological moment of rupture is instantaneously signalized by shock, profound and progressing; and following rapidly, contrary to established rules in other surgical conditions of shock, there is a hyperpyrexia which so crushes the vital energy and remaining sparks of life that the treatment can be only surgical, immediate and radical.

THE TREATMENT.—The patient should not be moved from the bed; an incision along the outer border of the left rectus allows easy access; clamping, tieing, and removal is a matter of only a short time. Large coagula, splenic pulp, and clots must be raked out of the pelvis and the hand run up under the diaphragm to remove any accumulation there. Infusion, autoinfusion, saline enema, the peritoneal cavity filled with normal salt solution, heart stimulants, and a moderate Fowler's posi-

tion with oxygen are the surgical procedures which should be tried as indicated.

A review of the foregoing shows twenty-eight reported cases of spontaneous rupture of the spleen in the course of typhoid fever, which with the unreported Münich cases, five in number, and Cantlie's five, make a sum total of thirty-eight cases. The condition was undiagnosed in every instance. In one (Case XXIV) aspiration of the splenic abscess was carried out successfully. In Case XX operation was performed for perforation, none was found; lineal rupture, the condition being unrecognized; the procedure abandoned, death. Case XXV, operation performed for perforation; ruptured spleen found and removed; death. In Case XXIX Ashby removed an enlarged unruptured malarial spleen in the course of typhoid fever. Recovery.

CONCLUSIONS.

1. That enlargement of the spleen to some degree is constantly associated with typhoid fever.

2. That splenic rupture in the course of typhoid fever occurs more frequently than is clinically recognized.

3. That many cases of lineal rupture have gone to death undiagnosed.

4. That many such cases have been diagnosed perforation and because of medical prejudice have been denied surgical help.

5. That it occurs most frequently in the beginning of the third week, and then during the actual stage of convalescence. This latter is probably explained by muscular effort.

6. That any reference to pain on the part of the patient under the left costal arch should put the attendant on his guard.

7. That the normal spleen cannot be palpated satisfactorily.

8. That the spleen does not have to assume great dimensions for spontaneous rupture (Case VII).

9. That the enlarged typhoid spleen should never be handled, but should be touched daily.

10. That marks upon the skin with the date at the end of the line would indicate the increase in size.

11. That in all cases of typhoid an ice-bag should be constantly applied to the spleen.

12. That in cases of enlarged spleen the patient should be bathed most gently and carefully.

13. That a sudden increase in the pulse-rate, 20 or 30 beats, at any time during the course of this disease, should be investigated thoroughly.

14. That if this increased pulse-rate is attended by evidence of shock (hemorrhage), the attendant should be notified instantly.

15. That if the liver dulness is not obscured, and a rapidly rising temperature soon sets in, rupture of the spleen is the tentative diagnosis.

16. That pain is an insignificant diagnostic sign of rupture.

17. That on diagnosis, infusion, and Fowler's position should be instituted immediately before operating.

18. That the use of adrenalin, ergot, and iron preparations would seem to be of little value.

19. That the only hope for recovery is in operation.

20. That in the course of operation for intestinal perforation the spleen should be gently palpated through the abdominal incision and, if like a bag of molasses, should be removed.

21. That all the grave complications of typhoid fever are essentially surgical.

22. That a typhoid state is no contra-indication for operation (Case XXIX).

23. That aspiration of the pus tumor can be carried out (Case XXIV).

24. That continuous peritoneal lavage with normal salt solution by means of two glass tubes, the giving one in the upper end of the incision (subdiaphragmatic) and the receiving tube a suprapubic stab, should be employed after removal of the organ.

25. That Roentgenography may be employed in suspected cases.

BIBLIOGRAPHY.

[1] Aaser, P.: "Miltruptur ned Tyfoidfeber," Tidsskr. f.d. Norske Lägeforen, 1898, vol. xviii, p. 21.

[2] Collin: "Spontanée déchirement de la rate dans fièvre entérique," cited by Vincent in Revue de Chirurgie, 1893, vol. xiii, p. 459.

[3] Craig, C. F.: "Rupture of Spleen; Report of Two Cases," Medical News, 1904, vol. lxxxiv, p. 780.

[4] Darwin, R. T.: "Rupture of the Spleen, in Fever," The Indian Med. Gazette, 1890, vol. xxv, p. 296.

[5] Erichsen, J.: "Milz-rupture bei einem Typhus-reconvalescent," St. Petersburg Med. Zeitschr., 1861, i, 3, p. 71.

[6] Lidell, J. A.: "Spontaneous Rupture of Spleen in Typhus Fever. Death. Autopsy," Amer. Jour. of Med. Science, 1867, vol. lxxix, p. 347.

[7] Nückel (Cologne): "Rupture der vergrösserten u. erweichten Milz," Schmidt's Jahrb., 1840, vol. xxvii and xxviii, p. 49.

[8] Peterson, O.: "Ueber Milzruptur bei Febris recurrens," St. Petersburg Med. Woch., 1882, vol. vii, p. 317.

[9] Santi, F.: "Un caso di rottura della milza in seguito a tifo abdominale," Gaz. d. osp. Milano, 1890, vol. xi, p. 340.

[10] Heimann (Moscow): "Ein Fall v. Typhus-Milz," Jour. d. prak. Heilkunde, Hufeland and Osann, 1843, p. 93.

[11] Griesinger: "Miltz Ruptur bei Abdominal Typhus," Handbuch. d. Acuten Infectionskrankheiten, 1874, vol. i, p. 165.

[12] Chrostowki B.: "Opeknieciach s'ledziony wogole, oraz dwa przypadki peknicia s'ledziony przy tyfusie brzusznym (Ruptures of the Spleen in General, and Two Cases of Ruptures of Spleen in the Course of Abdominal Typhus), In. Matlakowski (W.) Kriega pansietkowa. . . . Hoyerow, Wasszawa, 1884, p. 333.

[13] Afanassjeff, N. N.: "Rupture of Spleen in Typhoid Fever," Med. Obozr., Mosk., 1888, vol. xxx, pp. 3-16.

[14] Stengel, Alfred: "On Spontaneous Rupture of the Spleen in Typhoid Fever," Nothnagel's "Practice: On Diseases of the Kidneys and of the Spleen," American Edition, 1905, p. 671.

[15] Mosler, F.: "Ruptur der Milz u. ihres Gefässe"; "Kraukheiten d. Milz," Mosler, in Ziemssen Handb. d. spec. Path. u. Ther., 1875, vol. viii, 2 Hälfte, p. 144.

[16] Swaving, C.: "Spontane Zerreissung der Milz," Nederl. Weekbl. v. Geneesk., Amster., 1854, vol. iv, p. 341.

[17] Wittmann: "Abdominaltyphus mit Milzruptur," Jahrbuch. f. Kinderheilkunde, 1875-77, vol. ix and x, p. 329.

[18] West, J. W., and Dudding, T. S.: "A Case of Enteric Fever with Spontaneous Rupture of the Spleen," J. Roy. Army Med. Corps, London, 1906, vol. vii, p. 183; Lancet, 1906, vol. ii, p. 1230.

[19] Delafield, F. (N. Y., 1875): "Cause of Spontaneous Rupture of the Spleen in the Course of Typhoid Fever."

[20] Kernig, W.: "Ein Fall von Milz-Ruptur mit glücklichem Ausgang,"

St. Petersburg med. Zeitschr., 1876, vol. v, part iv, p. 315.

[21] Steudel, E.: "Ein Zweifelhafter Fall von Spontaner Milzruptur," Münchener med. Woch., 1895, vol. xlii, p. 97.

[22] Hartle, R. von: "Eine mit Glück behandelte Milz-krankheit im Typhus," London. Med. and Phys. Jour., October, 1825.

[23] Ashby, T. A.: "Case of Wandering Spleen, Complicated with Typhoid Fever. Recovery," American Gynecology, 1902, vol. i, p. 175.

[24] Baudel, R.: "Fall von Milzruptur infolge Abszessbildung bei Abdominaltyphus," Deut. Archiv f. klin. Med., vol. lxxxiv, No. 4.

[25] Adler, E.: "Zur Fruhdiagnose d. Typhus abdominalis durch d. Milzfunction, nebst einem Anhange uber die Gruber–Widalsche Blutserumreaction," Deutsche Archiv f. klin. Med., 1902, vol. lxxv, p. 549.

[26] Philipowicz: "Ueber d. diagnog. Verwerth. d. Milz-punction bei Typhus abdominalis," Wiener med. Blätter, 1886, No. 6.

[27] Neuhauss, R.: "Aus der inneren Abtherdung v. Bethanien," Berliner klin. Woch., 1886, vol. xxiii, p. 89.

[28] Laveran, A.: "Suppurations et Alterations Consecutose à la fièvre Typhoide," Soc. méd. des Hôp. de Paris, 1891, vol. viii, p. 90.

[29] Malinin, J.: "Die Milz hist. physiog, u. path. Bezich. bei intermit. Fiebern, u. beim Typhus," Virchow's Arch., vol. cxv, p. 303.

[30] Cantlie, J.: "Rupture of the Spleen," Medical Annual, 1903, p. 455.

[31] Boinet (Marseilles): "Spontan-Ruptur der Milz," Deutsche med. Woch., 1901, vol. xxvii, p. 294.

[32] Zimmermann, G.: "Emiges zur nächern Kentniss d. Typhusstühle," Deutsche Klinik, 1854, vol. vi, p. 205.

[33] Wilson, J. W.: "Spontaneous Rupture of the Spleen," British Med. Jour., 1878, vol. ii, p. 470.

[34] Vigla: "Spontanée Ruptur de la Rate," Recherches sur la Ruptur Spontanée de la Rate, Archiv. gén. de Méd., 4th series, 1843, vol. iii, p. 377, and 1844, vol. iv.

[35] Steffen, S.: "Zur Casuistik der Milzerkrank," Jahrb. d. Kinderhielkunde, 1881–2, vol. xvii–xviii, p. 88.

[36] Herrick, J. B. (Chicago): "On Spontaneous Rupture of the Spleen in Typhoid," in "Kidney and Spleen and Hemorrhagic Diathesis," W. B. Saunders & Co., 1905, p. 671.

[37] Carstens, J. H.: "A Short History of Splenectomy," N. Y. Med. Journal, and Phila. Med. Journal, for Nov. 18, 1905.

[38] Cohnheim, J.: "Tod durch Berstung von Varicen der Milz," Arch. f. Path., Anat., etc., Berlin, 1866, vol. xxxvii, p. 413.

[39] Skerritt, E. M.: "Spontaneous Rupture of Spleen Following Attack of Epistaxis, Death," British Med. Jour., 1878, vol. i, p. 641.

ILEOCOLIC INTUSSUSCEPTION IN AN ADULT.

WITH REMARKS ON THE METHOD OF FORMATION AND GROWTH OF THIS VARIETY OF INTUSSUSCEPTION.

BY JAMES SHERREN, F.R.C.S.,

OF LONDON,

Assistant Surgeon to the London Hospital; Surgeon to the Poplar Hospital for Accidents.

ILEOCOLIC intussusceptions have hitherto been placed in a separate class from all other varieties on account of the different manner in which their growth is supposed to take place. It is commonly taught that it occurs as the result of prolapse of the ileum through the ileocæcal valve, that increase in length takes place entirely at the expense of the entering layer, and that consequently its apex is continually changing; this is an entirely opposite mode of growth to that which takes place in other varieties of intussusception.

To quote from a recent account written by the late Harold Barnard [1]: "In simple ileocolic intussusception the ileocæcal valve remains fixed whilst more and more ileum is prolapsed through its orifice into the cæcum." This is the generally accepted method of growth, of the curious nature of which no satisfactory explanation is forthcoming.

The following case illustrates what I believe to be the correct method of formation of ileocolic intussusceptions, bringing them into line with all other forms.

Woolf K., aged 30, was admitted into the London Hospital under my care on February 25, 1909. While at his work as a paperhanger, twenty-four hours before admission, he was suddenly seized with cramp in the lower abdomen. He vomited within a few minutes of the onset of the pain, and vomiting continued at frequent intervals. Two hours after the commencement of the illness he passed two loose stools, which, when cross-examined after his recovery, he stated were "red." Except for this, there was absolute constipation. The pain after the onset continued to be paroxysmal and cramping. He gave no history before operation of the passage of blood and no mucus

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was passed. He looked ill, his face was pale, his eyes sunken, and he was groaning with pain. There was no doubt from his appearance that he was suffering from a severe abdominal lesion.

The abdominal wall moved fairly well, but there was slight rigidity in the right iliac region and an indefinite lump was present here. On examination per rectum, the rectovesical pouch appeared to be filled with fluid.

FIG. 1.
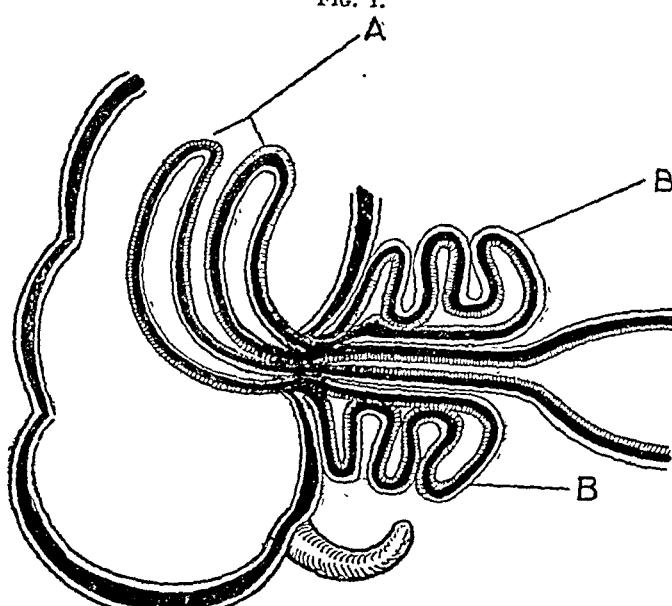
Diagram illustrates the condition found at operation. A, intussusceptum projecting into the cæcum through the ileocæcal valve. B,B, folded sheath of enteric intussusceptum.

It was obvious that he was suffering from acute intestinal obstruction, but I was unable to suggest its cause. I operated at once.

On opening the abdomen a considerable quantity of fluid escaped. Exploration revealed a mass in the ileocæcal region, evidently an intussusception. On bringing it outside I felt an elongated tumor in the cæcum. The ileum immediately internal to the cæcum was thrown into loose folds but the cæcal wall was not invaginated (vide Fig. 1). The condition was evidently an enteric intussusception in the process of passing through the ileocæcal valve. After squeezing its intussusceptum out through the ileocæcal valve, an ordinary enteric intussusception was left; this had started about a foot from the ileocæcal valve. I reduced it with considerable difficulty, and could find no cause for its commencement.

The patient made an uninterrupted recovery and left the hospital March 18.

But in addition to this mode of formation of an ileocolic intussusception as the result of the growth of an enteric, the condition may be primary and consist of the prolapse of part of the circumference of the ileum through the ileocæcal valve; but even in these cases no increase in size takes place at the expense of the entering layer, the ileocæcal valve, grasping the prolapsed ileum, passes on into the colon, forming a double intussusception. Special attention has been directed to the frequency of this form of intussusception by Corner [2] who named it "ileocolic-colic." In other cases the whole of the circumference of the ileum may be involved as the result of the unfolding of a small enteric intussusception just above the valve (Corner). In this form again no increase in size takes place, but it becomes an ileocolic-colic intussusception by involvement of the colon.

It is now over thirty years since Leichtenstern [3] described under the name "iliaca ileo colica" the variety of intussusception just recorded. He wrote of it thus: "A primary ileum invagination in the lower part of the ileum, which by its increase has passed its intussusceptum through the cæcal opening into the colon * * * * it cannot then be determined whether the invagination was primary ileocolic or iliaca ileo colica."

This does not seem to have received the notice it deserved, at any rate it has not obtained admission into the general surgical text-books in use in this country. It is mentioned in Sir Frederick Treves' monograph [4] and by Harold Barnard [5]; but these writers do not appear to have pointed out its bearing on the formation of ileocolic intussusception. Attention has recently been directed to this point by Fitzwilliams,[6] who, however, makes no mention of Leichtenstern's recognition of its occurrence.

The nomenclature of intussusception is still in a somewhat unsettled state. Undoubtedly the simplest and the best classification is that proposed by Cuthbert Wallace,[7] which I

have already advocated.[8] The term ileocæcal is confined to the variety of intussusception in which the apex of the intussusception is formed by the ileocæcal valve, and is dropped as the name of a class, the term enterocolic being employed.

The three groups are therefore: (1) enteric; (2) colic; (3) enterocolic.

The last named group, in which both small and large intestine are involved, is the most common, and contains many varieties of intussusception; the name ileocolic should be retained for one of these, remembering that it is a stage either in the growth of an enteric intussusception or in the evolution of an ileocolic-colic.

True ileocolic intussusceptions are uncommon. Out of 717 cases collected by Fitzwilliams[9] 67 were said to have been ileocolic. In the 45 cases upon which I have operated only 2 were ileocolic. The intussusception which starts as a small prolapse of the ileum into the colon and increases as a colic intussusception (ileocolic-colic) has been in my experience one of the most common forms of this disease.

To recapitulate: A complete ileocolic intussusception starts as the enteric variety. On reaching the ileocæcal valve the intussusceptum passes through, its apex as in other forms remaining unchanged. Further growth results in the colon participating, no fresh ileum is involved. When an ileocolic intussusception has been formed, whether as a small prolapse or as the result of the infolding of an enteric invagination, it does not increase in size by more ileum becoming prolapsed, but by the intussusception passing onwards in the colon and becoming ileocolic-colic.

REFERENCES.

[1] Allbutt and Rolleston: System of Medicine, vol. iii, p. 789.
[2] ANNALS OF SURGERY, Nov., 1903.
[3] Ziemssen's Cyclopædia of the Practice of Medicine, vol. vii, 1877, p. 613.
[4] Intestinal Obstruction, 1899, p. 145.
[5] Loc. cit., p. 790.
[6] Transactions of the Medical Society of London, vol. xxxi, 1908.
[7] ANNALS OF SURGERY, 1905, xli, p. 415.
[8] Clinical Journal, 1906, Jan. 3.
[9] Loc. cit.

A VERY EARLY FORM OF RENAL TUBERCULOSIS REVEALED BY NEPHRECTOMY.*

BY MARTIN W. WARE, M.D.,

OF NEW YORK CITY.

Adjunct Surgeon to Mt. Sinai Hospital.

THE routine of cystoscopic examination and ureter catheterization has in turn led to the prompt recognition of tuberculosis of the kidney, and hence the *pium desiderium* for an early recognition of this condition. The force of this teaching has gathered strength in its onward march, and yet it is a common experience to find that what passes for an early recognition of the lesion clinically can hardly be considered such in the light of the extensive pathological changes in the kidney, found *in situ* at operation, and still more clearly upon its removal.

The case herewith reported shows that the reverse may exist, a full appreciation of which fact and the lesson to be learned therefrom will be best gathered from the history and sequence of events in the course of operation.

CASE.—The patient, M. S., No. 100,143, aged 41, was admitted to Mt. Sinai Hospital May 26, 1908, He claims that after an attack of gonorrhœa, five years ago, a frequency of urination persisted with pain and that he felt as if he never completely emptied his bladder. Ten months ago, for a presumed stricture of the neck of the bladder as explanatory of his condition, he submitted to an operation of perineal section and galvanocaustic division of the stricture (?). No relief followed the operation. Thereafter he states the frequency of urination at night occurred at half-hour intervals.

Examination.—The urine was smoky and interspersed with particles of blood-stained tissue. Microscopic examination showed the presence of leucocytes and some few tubercle bacilli, the urine reacting acid. External genitals were normal in size and not hypersensitive. The prostate was moderately enlarged and tender. The capacity of the bladder was short of 125 c.c.,

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* Read before the American Urological Association, June 8, 1909.

and the introduction of the catheter and cystoscope alike painful.

Cystoscopy (Nitze cystoscope).—Right ureter, normal slit with a slight submucous hemorrhage. The left half of the trigone markedly different. The left ureter golf-holed and an ulcer in its vicinity and the surrounding mucosa injected.

Chromocystoscopy.—Following the intramuscular injection of 4 c.c. of a 4 per cent. solution of indigo carmine, the urine, stained faintly blue, issued from the right ureter after eight minutes, but none escaped from the left ureter after an observation of twenty minutes.

Ureteral Catheterization.—The right ureter could be easily entered and the urine obtained was slightly blood-stained, acid, and contained no pus and no organisms. Urea, 2.3 per cent. The culture showed *Bacterium coli.* The left ureter could only be entered for a distance of 1.5 cm., whereupon an obstruction was encountered in the repeated attempts made with ureter catheter to pass by it; the quantity of urine, however, too small for analysis, showed the presence of tubercle bacilli. On culture, *Bacterium coli* and staphylococci were found. On the basis of these findings an exploratory operation was proposed and accepted.

Operation.—An oblique lumbar incision was made and the lower pole of the left kidney was found to be on a level with the last rib and the kidney rather securely placed under the costal arch. Numerous fine adhesions were manually severed to mobilize the kidney, which on its cortex appeared normal. Whilst in the act of grasping the kidney to deliver it into the wound with gentlest of traction, an adhesion seemed to give way, followed by a profuse hemorrhage, which was controlled by pedicle clamps. The bleeding vessel could not be isolated sufficiently to apply a ligature. Advantage for the time being was taken of the hæmostasis effected by the clamps, and the kidney was split, according to Hyrtl-Zondek, from pole to pole. The bisection was naturally bloodless, and parenchyma, and *all of the kidney, to the fullest extent that it could be rendered visible in situ, showed absolutely no trace of disease.* Intending to save the kidney, it was sutured and several attempts were again made to isolate the injured vessel of the renal pedicle, which proved futile. Inasmuch as the clamps applied included so much, if not all of the vascular pedicle, nephrectomy became obligatory and ablation

FIG. 1

Tubercular ulcer of pelvis of kidney. (The ulcer seen on the papilla jutting into calyx above should have been below, the ureter having been drawn in the wrong direction.)

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of the kidney followed, with the clamps left *in situ.* The shocked condition of the patient and the loss of blood called for rapid work, hence no ligature was applied to the pedicle, which was short and greatly thickened by the cicatricial tissue surrounding it. The wound was tamponed with sterile gauze and the clamps removed on the fifth day. The subsequent healing of the wound was protracted over many months. This tardiness, as well as the flabby appearance of the granulations, in all probability due to an infection of the *terrain* of the operation by splitting of the kidney for inspection, emphasized anew the tuberculosis of the kidney removed.

DESCRIPTION OF THE SPECIMEN.

Macroscopic.—In the nascent state, when the kidney was still further divided so as to explore the interior of the pelvis, an irregular undermined necrotic ulceration 0.5 cm. in diameter was disclosed near the lower pole, on the tip of a papilla jutting into the lower calyx (Fig. 1). In good light, it was easily recognized that the color of the papilla was much paler and of a yellowish-white color, the markings not as discernible as in other papillæ, and the distinctions at the confines of cortex and medulla effaced.

Microscopic Examination.—Tubercle bacilli were recovered from the scrapings of the base of the ulcer. Sections about the papilla showed lymphoid reticulated stricture, with areas of poorly stained cells due to necrosis, characteristic of tuberculosis. Towards the base of the papilla the process was older, as evidenced by the increase of the interstitial fibrous tissue, which had replaced the destroyed tubules. In some of the ureter saved from the fragmentary condition of the pedicle necessitated by the exigencies of the case, distinct tubercles and giant cells were to be seen.

Epicrisis.—But for the accidental injury of the vessels, we should have improperly judged the kidney to be the seat of no tuberculous lesion, because there were no signs of such visible in the cortex or kidney parenchyma exposed to view. The subsequent findings as well as the consequent tedious behavior of the wound point to an infection of the field from the exposed diseased parenchyma.

The significant lesson to be learned from this single experience is that if ureter catheterization shows the presence of undoubted tubercle bacilli,[1] immediate nephrectomy is none the

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[1] This dictum does not apply to cases of tubercle bacilli eliminated in urine without urinary symptoms or signs.

less indicated, without division of the kidney, to confirm the findings in the face of doubt arising because of the absence of superficial lesions.

In other words, the finding of tubercle bacilli by ureter catheterization is paramount to and renders superfluous subsequent exploratory nephrectomy. By such a procedure in very early cases, and all the more so in advanced tuberculosis with apparent lesions, the chances of infecting the wound and causing a tardy convalescence are reduced to a minimum.

Because of the stricture in the lower end of the ureter and the findings of tubercles in the upper ureter, and the location of the ulcer in the lower calyx, contiguous to the diseased ureter, the question might arise: Was not this an ascending tuberculosis? Against this it will suffice to point out that the entire pyramid belonging to the papilla was diseased and the changes near the base were of a fibrous character.

We can assert merely speculatively that with the tendency to stricture formation of the ureter its ultimate obliteration was likely, and this patient if not operated upon would have eventually developed a closed tuberculosis of the kidney, none the less calling for ultimate surgical intervention.

End Result.—Relief from the painful and frequent micturition followed the nephrectomy. The urine also cleared, and this amelioration remained for six months. At the expiration of this time a return of these symptoms set in, associated with a left-sided tuberculous epididymitis so acute in its development and so extensive that a castration was performed. The vas was as thick as a lead pencil and the cord structures much thickened. Though the immediate result was primary union, two months later a sinus formed which yielded admirably to treatment with the Bier cup.

In the meantime hæmaturia has appeared on several occasions, which the cystoscope showed to come from the very much engorged prostate and large vessels overlying. From the left ureter clear urine is seen to issue. Notwithstanding these complications, the patient's general health is good and he has gained 10–12 pounds.

THE SURGICAL TREATMENT OF NON-RESILIENT DIVERTICULA OF THE BLADDER.*

BY EDMOND M. VON EBERTS, M.D., M.R.C.S. (Eng.),

OF MONTREAL,

Surgeon to the Out-patient Department of the Montreal General Hospital.

THE comparative infrequency of large diverticula of the bladder has prompted me to report in detail a case which I have observed, and to review the methods employed in the surgical treatment of this affection.

While cystoscopists of experience are apparently agreed that diverticula of the bladder associated with urethral or prostatic obstruction or the presence of stone are relatively frequent, such sacculations, whether single or multiple, are usually unassociated with peridiverticular adhesions and tend to disappear after the removal of the cause of increased intra-vesical pressure. In this connection I wish to deal only with that form of diverticulum, usually of large capacity, which,' owing to the existence of adhesions to the surrounding organs or to the paucity of the muscular element in the sac wall, is characterized by the absence of expulsive force. From the point of view of pathogenesis one should not include as true diverticula those cases which are a sequence of perivesical suppuration, although from the point of view of diagnosis and treatment they are indistinguishable from such as result from attenuation of the bladder wall through pressure.

VARIETIES.—Large diverticula may be either congenital or acquired. I am not aware of any case in which a diverticulum has been found post mortem in infancy; Pean's [1] case, however, strongly supports the congenital theory, as does a case reported by Hofmokl and Ghon,[2] especially as in the female the conditions chiefly considered as causative factors,

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* Reported in the Surgical Section of the Canadian Medical Association, August, 1907.

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such as urethral stricture and prostatic hypertrophy, do not exist. Nor was there found in these cases any evidence of spinal injury or disease.

SYMPTOMATOLOGY.—The variations in the symptom complex in vesical diverticula are so numerous that I have given somewhat in detail the symptomatology in each case of the series reviewed. A case reported by Murchison [3] illustrates in a striking way the occasional obscurity of the urinary relation and the difficulties of diagnosis where cystoscopy cannot be carried out. Generally speaking, however, the symptoms complained of are those of an acute cystitis, that is, pain, frequency of micturition, and the passage of cloudy, malodorous urine. Micturition may be associated with severe tenesmus. The frequency with which a tumor has been found, generally situated to one side of the median line, is noteworthy. Possibly, however, the most characteristic symptom is the ability of the patient to repeat the act of micturition after a short interval. In such cases the introduction of a catheter after voluntary urination usually evacuates a large residue. While the stoppage of the stream in the first act is no doubt due to the passage of the vesical contents in the direction of least resistance, that is, into the diverticular sac, a reversal of this process is initiated as soon as the expulsive efforts of the bladder cease, and continues until the pressure in the two cavities is equalized. Where the diverticulum occupies a dependent position there is always residual urine, and one generally fails in attempts to wash the bladder clean,—which adds greatly to the difficulties of the cystoscopist. The writer's case illustrates very well this latter point, as upon first examination, owing chiefly to the fact that the distending fluid was cloudy, the presence of a diverticulum was overlooked.

In the majority of cases there is a history of recurring febrile attacks associated with chills, with or without symptoms of renal involvement.

Where the diverticulum replaces an abscess cavity, there is of course a history of the sudden evacuation of a large amount of purulent urine. This symptom of urgency is also

associated with those cases in which a sudden evacuation of the diverticular contents follows periodical occlusion of the orifice.

COMPLICATIONS.—The burden of the literature on this subject deals with post-mortem findings, the cardinal complications observed being severe vesical or diverticular inflammations, displacement and dilatation of the ureter, pyonephrosis, perivesical abscess, peritonitis, and femoral thrombosis. Pressure upon and deflection of the ureter above its intramural course is a frequent complication and leads eventually to dilatation of the ureter and of the renal pelvis. With the advent of infection there follows, in consequence of the ureteral obstruction, widespread renal suppuration and impairment or destruction of the renal function. In the author's case the renal symptoms were decidedly the most striking when the patient first came under observation, the presence of a diverticulum remaining unrecognized for some time. In Cases III, V, and VII of the series reviewed the diverticular orifice was found to occupy the normal site of one of the ureters, and the ureter of the corresponding side to discharge directly into the diverticulum. Careful perusal of the cases reported strongly substantiates Young's [4] opinion that this condition of affairs is due to a gradual inversion of the ureteral orifice through extension of the diverticulum and not to sacculation of the ureter itself.

TREATMENT.—*Catheterization.*—The use of the catheter for retention and irrigation is at best a makeshift, as, owing to the fact that the communication with the bladder seldom provides dependent drainage, irrigation cannot possibly give permanent relief or even free the urine from pus. There are no successful results recorded from this method of treatment.

Drainage.—Suprapubic cystostomy undoubtedly gives temporary relief and is properly undertaken in weak individuals. The absence of resiliency in the diverticulum, however, deprives this method of treatment of any permanent value. In a case reported by Burckhardt [5] a perineal drain was inserted, but the patient died.

Enlargement of the Orifice.—In considering this form of treatment the position of the diverticulum must be one's chief guide. Where the accessory sac is found to underlie the trigone of the bladder, or where the most dependent portion of the diverticulum is on a lower level than the base of the bladder, treatment by this method cannot be expected to yield.

FIG. 1.
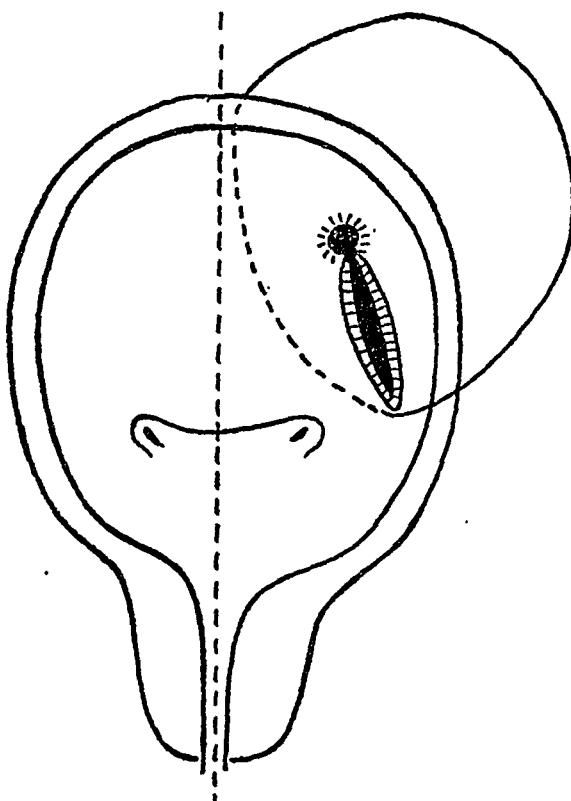
Illustrating operation of enlargement of orifice.

a cure. Where, however, the diverticulum is in the course of the urachus, or is so placed that the incision may be carried to its lowest level and still be above the base of the bladder, it is conceivable that the result might be satisfactory, provided there remained no obstruction in the course of the urethra, either from enlarged prostate, spasm of the sphincter, or urethral stricture. As the reflection of the diverticular wall upon the outer surface of the bladder may extend for only a

short distance around the opening of communication, the corresponding cut edges of the bladder and diverticulum should be carefully approximated by sutures in order to forestall the danger of an extravasation into the pelvic cellular tissue. A case reported by Young[4] in which this method of treatment was followed, resulted in the re-establishment of voluntary micturition but a residual urine of 300 c.c. necessitated the use of the catheter at bedtime (Fig. 1).

Suture of the orifice of the diverticulum without excision of the sac has been practised by Pousson,[6] who reports a case in which after the mucosa of the diverticulum had been thoroughly curetted and the margin of the orifice freshened, closure was effected by means of catgut sutures. The operation is said to have been successful; but the procedure, for very patent reasons, is not to be recommended.

Complete Excision of the Diverticulum.—This would appear to be the only method yielding permanently satisfactory results. Where obstruction is present it should be dealt with primarily, or at least at the same time that the excision of the diverticulum is carried out. Further, in cases where pyonephrosis exists as a complication, and examination of the segregated urine shows extensive impairment of the renal function, it would seem rational to deal in a radical way with the complication before attempting bladder suture in the presence of a constant inflow of purulent material.

The literature contains the reports of ten cases treated by complete excision, which owing to the varied symptomatology and different operative methods employed are, in addition to the author's case, given somewhat in detail.

CASE I—(AUTHOR'S CASE, 1906).—R. F., aged 32, was first seen on October 27, 1906. His complaints were pain in the right loin, frequency of micturition, interruption of the stream, and attacks of fever. His family history was negative.

Personal History.—Since adolescence he had experienced difficulty in emptying the bladder, the act requiring as a rule several minutes. In 1897 he contracted a severe urethritis, which became chronic and was complicated at first by cystitis and later by what

was diagnosed as pyelitis. Subsequently there was marked impairment of health; the urine from time to time became extremely cloudy and fetid; and frequent attacks of cystitis, occasionally complicated by retention, necessitated the use of the catheter. Throughout this period a marked irritability of the sphincter urinæ led to frequent interruptions in the act of micturition. In 1902 the patient was sent to Arizona for one year, where he subsisted largely on a milk diet with beneficial results. After his return to work he was from time to time interrupted in his vocation by attacks of cystitis, necessitating bladder lavage and the use of urinary antiseptics. In August, 1906, a severe febrile attack intervened, associated with pain in the right side. In September a second and in October a third attack similar in every way occurred. It was during convalescence from the last attack that the patient came under my observation.

On examination there was found tenderness on deep pressure in the right flank. The bladder dulness extended above the symphysis half-way to the umbilicus. The urine was cloudy, specific gravity 1.018, acid, and contained albumin, casts, and a large quantity of pus. The residual urine amounted to 200 c.c. The act of micturition was prolonged by pressure upon the lower abdomen. The evening temperature was 103° F., falling to 99° in the morning.

Digital examination of the rectum showed the prostate to be normal; the seminal vesicles were slightly thickened and somewhat tender. Above the prostate, extending to the right, could be felt a large, boggy mass which was considered to be a dilated, atonic bladder.

A cystoscopic examination by Dr. R. P. Campbell on October 30 revealed the following facts:

The bladder held 350 c.c. with but a slight feeling of distention. The bladder wall was hypertrophied and trabeculæ were everywhere visible; some cystitis was present, most marked about the trigone, but not sufficient to account for the quantity of pus present. The urethral orifice appeared normal and the ureters were easily catheterized. The right ureteral terminal was displaced towards the median line. The urine from the right ureteral catheter flowed steadily drop by drop (evidently from a dilated ureter) filling two test-tubes, while the secretion from the left side, flowing at a normal rate, filled one-half a test tube.

The urine collected by catheter from the bladder and from the two kidneys when compared showed:

	Common	Right	Left
	Turbid	Turbid	Clear
	Acid	Acid	Acid
Specific gravity 1010		1009	1025
Albumin ....Present		Present	Trace only
Urea		0.8 per cent.	2 per cent.
	Pus	Pus	No pus
	Bacteria	Bacteria	No bacteria
	Blood cells		
Cultures ....B. pyocyaneus		B. pyocyaneus	An occasional
	B. coli		colony of
			B. coli

Diagnosis.—Spasm of the sphincter, hypertrophy and dilatation of the bladder, chronic cystitis, dilatation of the right ureter (above the ureteral sphincter), chronic suppurative pyelonephrosis.

Rest in bed and lavage of the bladder effected within a few days a marked improvement in the patient's general condition, the evening temperature falling to 99½°. An attempt was made by means of vaccines prepared from devitalized cultures to induce a bacterial immunity to both *B. pyocyaneus* and *B. coli communis* under strict opsonic observations. Before inoculation with composite vaccine the index to *B. pyocyaneus* was 1.25; and that to *B. coli*, 2. On November 18 the indices were 2.5 and 6 respectively. At this time the temperature showed an increase in the evening registration; and, fearing a recurrence of the former severe febrile symptoms with attendant toxæmia, I decided to remove the right kidney.

On November 22 a nephrectomy was performed under ether anæsthesia. As was expected the ureter, pelvis, and calices were found greatly dilated. Secreting tissue remained in isolated areas, chiefly at the two poles; and there could be seen macroscopically numerous small abscesses throughout the gland. Cultures from the pelvis of the kidney upon agar slants yielded within twenty-four hours pure growths of *B. pyocyaneus*. Following the operation there was an immediate cessation of the pyrexia. As, however, in spite of daily irrigation of the bladder the urine continued to be cloudy, on December 5 under a general anæsthetic a suprapubic drain was inserted. On exploration of

the interior of the bladder a small opening was observed to the outer side of the right ureteral orifice through which purulent material exuded. A probe thrust into this opening could be felt per rectum to pass to the posterior wall of the pelvis. The orifice of communication was found to admit readily large blunt forceps, through the open jaws of which a drainage tube 1 cm. in diameter was inserted. The anterior extremity of the tube was then sutured to the margin of the suprapubic wound.

Following this procedure the urine showed a very marked decrease in the amount of pus present. At the end of ten days the diverticulum tube was removed and at the end of three weeks the suprapubic opening was allowed to close. The temperature maintained an afebrile course. During the next two months the bladder was irrigated daily; and upon several occasions the suprapubic wound closed, only to open again in from four to six days. Throughout this period it was noticed that although micturition could be readily initiated, the stream rapidly declined after the passage of 240–280 c.c. A few minutes later the patient was able to pass a similar amount, this state of affairs being due evidently to the passage of the urine on contraction of the bladder into an accessory cavity offering less resistance than the *via naturalis*. It was further observed that if catheterization were employed, the instrument if re-introduced in ten or fifteen minutes evacuated a further amount of 180–250 c.c.

A cystoscopic examination was again undertaken and the existence of a large diverticulum demonstrated. The opening from this into the bladder was found about 2.5 cm. to the outer side of the right ureter. This cavity was further determined to be of large dimensions, probably capable of holding 200–250 c.c., as it was possible to introduce the cystoscope through the opening (1 cm. in diameter) into a cavity which appeared to be almost as large as the bladder itself.

Operation, February 28.—Extravesical, extraperitoneal excision of the diverticulum; re-establishment of suprapubic drainage.

Under ether anæsthesia a vertical incision was made through the lower segment of the right rectus muscle. The peritoneum was readily stripped back to the upper margin of the diverticulum; but owing to the close adhesion of the wall of the accessory cavity to the outer surface of the bladder for some distance from the opening of communication, it was found impossible to isolate

the neck of the sac without re-opening the suprapubic wound. With the tip of the left forefinger passed through the orifice of the diverticulum and used as a retractor and guide, the separation of the diverticulum from the bladder was readily effected. After the neck of the sac had been divided, the bladder was closed extravesically by means of a purse-string suture. This was re-inforced and the bladder wall further inverted by a continuous catgut suture. The enucleation of the sac presented little or no difficulty. It was found to extend below for a considerable dis-tance undermining the trigone, behind to the posterior wall of the rectum and laterally to the pelvic wall. Drainage of this cavity was provided by means of a rubber tube passed behind the prostate and through the perineum without communicating with the urethra. Complete closure of the lateral suprapubic incision and partial closure of the suprapubic wound after excision of scar tissue concluded the operation. Intravesical pressure was pro-vided against by means of a small suprapubic siphon. Convales-cence was rapid and uninterrupted. The perineal drain, which was apparently unnecessary, was removed on the third day; and at the end of three weeks, after I had determined by cystoscopic examination through the suprapubic wound that the diverticular · opening was firmly united, the suprapubic siphon was removed.

A microscopic examination of the excised diverticulum showed the wall to consist of several·layers of flattened cubical epithelium; a well-defined submucosa; muscle bundles running in various directions; and externally a layer of loose connective tissue.

Owing to the recurrence from time to time of a suprapubic fistula, the patient was given an anæsthetic on May 18, and the sphincter urinæ dilated to 42 F. with a Kollmann instrument. The suprapubic wound closed finally within ten days.

On June 15 the patient was discharged well. The urine at this time was clear and contained but few pus cells and bacteria. The residual urine varied between one and two ounces.

Subsequent History.—Apart from a mild attack of prostatitis in May, 1908, at which time there was a residual urine varying between one-half and two ounces, the patient has been free from urinary symptoms.

Remarks.—In reconsidering this case in detail, I am of the opinion that the diverticulum was most likely congenital in origin, although I am aware that this is not capable of

proof; the early symptoms, however, support this view. With such a condition existing an infection alone was necessary to produce the subsequent train of symptoms; this in time arrived. It is further probable that infection of the kidney was favored by the pressure of the diverticulum upon the ureter at some little distance from its vesical orifice. This theory would also account for the extreme dilatation of the ureter without involvement of its vesical terminal.

FIG. 2.
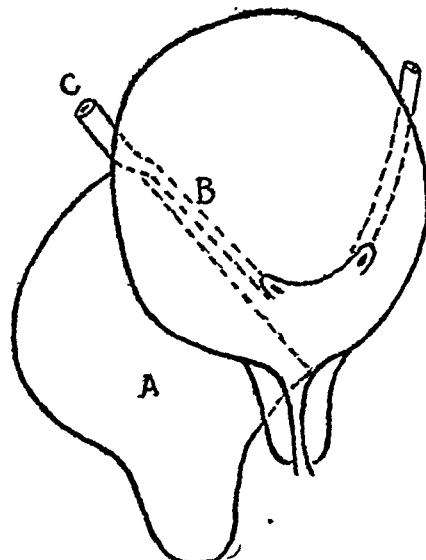
Illustrating author's case. A, diverticulum; B, displaced ureter and ureteral orifice; C dilated ureter above intramural course.

If the diverticulum were of recent development, the spasm and hypertrophy of the sphincter must be considered the etiological factor, as they furnished sufficient obstruction to produce sacculation. As an illustration of the degree of obstruction produced by the sphincter, one has only to recall the repeated failures to close the suprapubic wound (Fig. 2).

ABSTRACT OF CASES.

CASE II (PEAN,[1] 1895).—Congenital vesical diverticulum and supernumerary urethra in a girl aged fifteen. There had been incontinence from birth. On examination there was found on the anterior wall of the vagina a median protrusion the size of a nut. On digital pressure over the tumor urine was seen to escape from a narrow opening placed in the median line 3 mm. below the external orifice of the urethra. On the

supernumerary external orifice being obstructed with the finger and pressure again exerted, there was a gradual diminution in the size of the tumor and the patient complained of a desire to urinate. Under a general anæsthetic an incision was made over a director along the anterior wall of the vagina, the diverticular tract excised, and the opening into the bladder sutured. The patient was cured.

CASE III (CZERNY,[1] 1896).—A young man, aged 31 years, developed after traumatism a stricture of the membranous portion of the urethra, followed by retention, cystitis, and pain in the region of the left kidney. On examination there was found to the left of the median line a tumor the size of a child's fist which on compression discharged its contents into the bladder. Suprapubic cystostomy disclosed a greatly thickened bladder with a finger-shaped prolongation towards the navel. In the region of the left ureteral orifice a large diverticulum was demonstrated, the opening of communication admitting the finger. The accessory sac completely filled the small pelvis, and contained foul urine and epithelial detritus. Suprapubic drainage was continued for a fortnight without freeing the urine from pus, and excision of the diverticulum was decided upon. The left rectus was incised transversely. Many adhesions were encountered, especially in the region of the rectum and in the hollow of the sacrum. During the operation the peritoneum and the left ejaculatory duct were injured. The left ureter was dilated and passed obliquely through the wall of the diverticulum. It was divided and implanted into the bladder wall. The wall of the excised diverticulum contained muscular and epithelial elements. Convalescence was retarded by the formation of a ureteral-abdominal fistula. Four months later the left kidney, the seat of pyonephrosis, was extirpated. At the time that the patient was discharged, the bladder held 150 c.c. and he was able to retain his urine from two to three hours.

CASE IV (RIEDEL,[2] 1903).—The patient, aged 61 years, was admitted to the Surgical Clinic in Jena on December 20, 1902. He had experienced difficulty in urinating for three years. Latterly the use of a catheter had been necessary. On examination there was found marked enlargement of the prostate. Prostatectomy was performed. Five months later, in May, 1903, symptoms of obstruction returned, with pain in the right side above Poupart's ligament, for the relief of which a perineal section was performed. On June 13, 1903, suprapubic cystostomy revealed the presence of a large diverticulum communicating with the bladder through an opening 2 cm. in diameter. The bladder was closed and a second incision made through the right rectus muscle. The accessory sac was excised and the communication with the bladder closed with catgut suture. Perineal drainage was re-established. Collapse and death occurred on the following day.

CASE V (PAGENSTECHER,[3] 1904).—The patient, a male aged 33 years, was seen in August, 1903. During the preceding winter he had suffered for two or three days from pain in the bladder and on micturition. Five weeks later the pain had returned with strangury and tenesmus every half hour. On admission the distended bladder could be felt above the

pelvic brim. After evacuation with a rubber catheter, a solid instrument when introduced withdrew a further amount of turbid, bloody urine, and the abdominal tumor disappeared. On subsequent irrigation the bladder was found to hold as much as one litre. Cystoscopy was unsuccessful; and on August 30, 1903, suprapubic exploration was undertaken. In the position of the left ureter was found the opening of a large diverticulum.

As there was no improvement in the patient's condition following drainage, extirpation of the diverticulum by the sacral route was carried out on December 16. The left ureter, which opened into the accessory cavity, was implanted into the bladder at the former opening of communication. A self-retaining catheter was placed in the urethra. The excised sac contained in its walls bundles of smooth muscle fibres running in various directions and a well-marked submucosa. Of the epithelial lining only a few fragments were preserved, In addition to a sacral fistula the suprapubic wound continued to discharge for some time. In February both fistulæ had healed, but in March the sacral fistula reopened, urine escaping during micturition.

CASE VI (VON EISELSBERG,[10] 1904, reviewed by CHRISTIE).—In the discussion upon Pagenstecher's paper, von Eiselsberg reported a case of vesical diverticulum which had come under his observation, in which a palpable suprapubic tumor disappearing under pressure was followed by a desire to micturate. The presence of a diverticulum was confirmed by cystoscopic examination, the orifice of communication with the bladder being situated at the base. Excision of the sac was successfully practised. Details as to operative procedure and histological examination of the sac wall are not given.

CASE VII (YOUNG,[4] 1904).—The patient, a male aged 30 years, was seen in January, 1904, complaining of frequency of micturition and pain in the back. There was a history of severe attacks of urethritis in 1893 and 1898. During the last attack a tight stricture in the bulbomembranous region was found to exist, for the relief of which a combined external and internal urethrotomy was performed. During the next three years the patient was free from urinary symptoms. About April, 1902, he had an attack lasting one week, characterized by obstruction and frequency of micturition. Three months later a second attack similar in every way occurred. In September, 1903, a third attack supervened, and in October a fourth attack with pain in the right side of the pelvis and severe tenesmus culminated in the sudden passage of a quantity of pus. It was thought that an abscess had ruptured into the bladder. Although retention occurred, a catheter could be passed without meeting with obstruction. Bladder lavage was practised without diminution in the amount of residual urine. On December 9 pain and tenderness developed in the right flank beneath the costal margin. On January 4, after coming under observation, the patient had a similar attack lasting several hours, which necessitated the use of morphine. At this time fever, nausea, and the presence of muscular rigidity over the right kidney were observed. Examination showed the prostate to be slightly harder than normal, but there was no evidence of stricture. There was a residual urine of 350 c.c. The bladder

was washed clean with difficulty. Pressure on the lower abdomen was necessary to evacuate completely the bladder contents. The cystoscope revealed a large diverticulum with an orifice of communication 2 to 3 cm. in diameter, situated in the position of the right ureteral opening. The left ureteral orifice was found displaced towards the left, with the opening of a second and smaller diverticulum lying above and to its outer side. The right ureteral orifice, of course, could not be seen, but it was subsequently found to open upon the inner wall of the larger diverticulum. For six weeks catheterization and lavage were practised, but without diminution in the size of the diverticulum or in the quantity of residual urine.

FIG. 3.
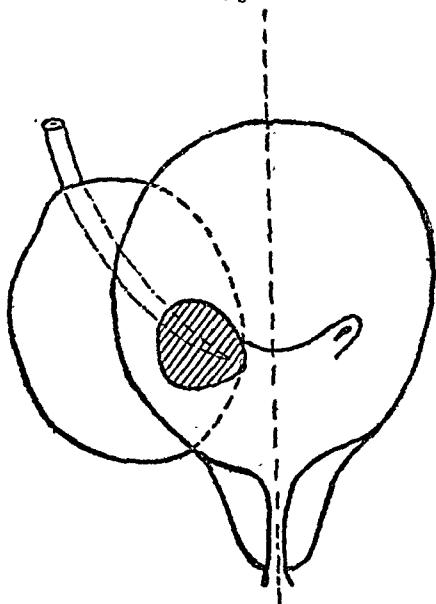
Illustrating Case VII (after Young).

Operation, February 10. Suprapubic extravesical excision of the large diverticulum with closure of the orifice was carried out; also drainage of the bladder through a perineal urethrotomy and drainage of the retrovesical space by means of a tube passed behind the prostate and through a posterior perineal incision without entering the urethra. The intradiverticular emplacement of the right ureteral orifice was brought forward by means of a flap operation (Fig. 3).

Owing to the failure of the suprapubic wound to heal, the presence of 30 c.c. of residual urine, and the recurrence of a small pouch at the site of the excised diverticulum on the right side—all indicating obstruction—a Bottini operation was performed on August 4.

Examination of the wall of the excised diverticulum showed the presence of an epithelial lining and numerous layers of smooth muscle-bundles running in various directions. There was also present the usual evidence of chronic inflammation.

Five months after operation the patient reported his urine to be clear and the function of urination normal.

CASE VIII (YOUNG,[4] 1904).—Male, aged 34 years, was admitted to the Johns Hopkins Hospital on January 18, 1904. In March, 1899, the patient jumped from a moving locomotive, striking upon the buttocks. Following the accident he felt severe pain in the lower portion of the abdomen, and on examination found a lump about the size of a hen's egg below and to the left of the umbilicus. This swelling gradually subsided. There was, however, a return of the pain at the site of the tumor if the bladder were allowed to become distended.

On cystoscopic examination there was found in the region of the vertex the small orifice of a diverticulum. The bladder wall was not trabeculated.

FIG 4.
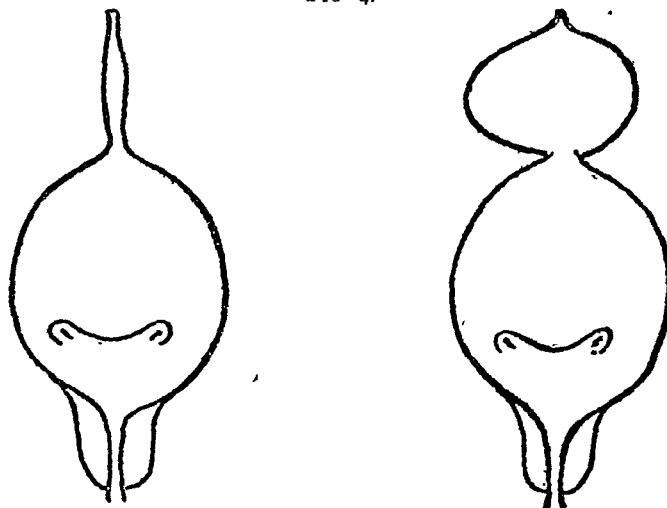
Diverticula in the course of the urachus (after Young).

Operation, January 28. Excision of a small diverticulum lying within a dilated urachus. On February 23 the patient was discharged well (Fig. 4).

CASE IX (YOUNG,[4] 1903).—Male, aged 63 years, was seen in February, 1903. In 1901 the patient first noticed frequency of urination and difficulty in starting the stream. At the time of admission urine was voided about every fifteen minutes. The patient had never had complete retention and a catheter had never been used.

On examination the urine was found to be normal. The prostate was moderately enlarged. On passing a catheter 1200 c.c. of residual urine was withdrawn. Cystoscopic examination showed intravesical prostatic hypertrophy, moderate trabeculation of the bladder wall, and on the right side anteriorly the opening of a diverticulum.

Operation, February 22. Suprapubic extravesical extraperitoneal excision of the diverticulum with suture of the orifice of communication; perineal prostatectomy. Enucleation of the diverticulum was effected without difficulty owing to the absence of dense adhesions. The capacity

of the diverticulum was estimated at 500 c.c. The bladder itself was not opened. The patient was discharged well on the twenty-seventh day following operation.

Microscopically the mural elements consisted of well-defined mucous, submucous, and muscular layers. There was no evidence of inflammation.

CASE X (PORTER,[11] 1907).—This patient, a male aged 34 years, first came under observation in April, 1906, complaining of difficulty in starting the stream, of frequency of micturition, and of the passage of foul urine which occasionally contained clotted blood. On examination the bladder was found to extend to the umbilicus. The residual urine varied from 19 to 24 ounces. Treatment at this time was declined. When the patient returned one year later, digital examination of the rectum showed the prostate to be moderately enlarged and cystoscopy revealed the presence of three diverticula, one of which was especially large, with its orifice of communication situated at the right side of the base of the bladder.

On April 30 suprapubic drainage was established. On May 21 the bladder was reopened suprapubically, and the sphincters of the diverticula widely dilated. The patient was discharged in August, but leakage still occurred from the suprapubic wound.

He returned in September suffering from epididymitis and pain in the region of the left kidney.

Operation, September 8. An incision was made parallel with Poupart's ligament. The peritoneum was opened and an elastic swelling the size of a banana, extending backward and to the left of the base of the bladder, was found. In order to separate the accessory sac from the rectum the bladder was again opened and the forefinger inserted into the diverticulum as a guide and retractor. The orifice was closed with two layers of catgut sutures. Suprapubic drainage was provided and a rubber catheter placed in the urethra. At the end of October the patient was reported to be much improved in health, but in the absence of urethral drainage leakage still occurred at the site of the bladder suture.

CASE XI (WULFF,[12] 1904).—The patient, a male aged 34 years, first experienced difficulty in micturition in May, 1903. In July, while confined to bed, he suddenly lost the power of voluntary urination. A large quantity of urine was withdrawn by catheter. Although voluntary micturition was subsequently restored, there remained a residue of one litre which, however, did not produce discomfort. The condition was at first thought to be due to a disturbance of the sensory nerve supply. On examination some months later there was found in the right lower quadrant a large tumor, which catheterization failed to reduce but which on pressure suddenly discharged into the bladder a large quantity of fetid, brownish-yellow fluid. Cystoscopy showed the presence of a diverticular opening on the right side.

Operation.—An incision was made parallel with Poupart's ligament, the peritoneum stripped back, and the diverticular sac opened and evacuated. The cavity was then tamponed.

Three weeks later the sac was resected and the orifice of communication with the bladder sutured. Intravesical tension was provided against by means of a permanent urethral catheter.

Several weeks later, owing to the failure of the bladder suture line, the opening into the bladder was again exposed and the edges freshened and resutured. At the end of a further period of several weeks the patient was discharged. The wound had healed. The urine, voided spontaneously every three hours, was for the most part clear. There was a residue of 150–200 c.c. On cystoscopic examination the mucous membrane at the site of the suture was found to be firmly united. Whether the presence of the residual urine was due to atony of the vesical wall following the prolonged distention, or whether due to defective enervation, had not been determined. The wall of the excised sac contained epithelial and muscular elements.

ETIOLOGY.—Of the series of eleven cases reviewed, I, II, V, VIII, X, and XI belong to the congenital variety, although positive evidence of congenital origin can be said to exist only in Case II, reported by Pean.[1] In this connection it is fallacious to lay too much stress upon the presence of bladder epithelium and muscular tissue in the wall of the accessory sac, as these elements may be present in cases where prostatic hypertrophy has been considered the etiological factor (IX) and also in cases in which a urethral stricture has existed (III and VII).

To prostatic enlargement may be ascribed the development of the diverticulum in Cases IV and IX. Porter's[11] case may belong to this category. The note on the prostatic condition is not very definite. While the age would suggest a congenital origin, it does not exclude a prostatic causation.

Urethral stricture was present in Cases III and VII. Owing to the persistence of obstructive symptoms (that is, pouching of the suture line and residual urine) after extirpation of the diverticulum, a Bottini operation was performed in Case VII with permanently satisfactory results.

The etiological factor in the case reported by the writer must remain in some doubt; the history on the one hand suggests the possibility of the diverticulum having been congenital, while on the other the presence of hypertrophy and spasm of the sphincter urinæ cannot be left out of consideration.

Traumatism was undoubtedly the exciting cause in Case VIII. The urachus had probably remained patent from birth.

Perivesical suppuration has to be considered as possibly the precursor of the diverticulum in Case VII, in view of the history of a sudden evacuation of a large quantity of pus. Opposed to this theory are the facts that a stricture had existed in the bulbomembranous portion of the urethra and that the diverticulum was lined with epithelium and contained muscular elements in its wall.

While no case of diverticular formation secondary to congenital stricture of the meatus urinarius has been reported, the possibility of this condition figuring as an etiological factor should be borne in mind.

Phimosis was associated with the formation of a vesical diverticulum in a child 21 months old, observed by Lennander [13] and cited by Young.[4]

Spinal injury or disease as an etiological factor was first suggested by Hale White.[14]

Von Eiselsberg's [10] case (VI), owing to the absence of details, cannot be classified.

AGE.—It will be seen from the foregoing that. apart from Cases IV and IX (prostatics, aged 61 and 63 years respectively) and the case reported by Pean,[1] all those included in our series occurred in individuals between the ages of thirty and thirty-four. This fact is most striking and suggests the possibility that they were all congenital in origin; that is to say, even the two cases with a history of pre-existing stricture present features which bring a congenital hypothesis within the limit of reason.

PROGNOSIS.—Out of the eleven cases reviewed. the operation of excision of the diverticulum was followed by the restoration of the normal function of urination in eight instances. In two cases urinary fistulæ persisted at the time of their being reported, and in one case the operation was followed by collapse and death. The age at which the majority of these cases occur imposes a grave responsibility upon the surgeon. With modern methods of investigation, physical, biological, and chemical, applicable to the urinary tract, a correct diagnosis should practically always be made early in

and unbearable pains all over the body forced her to seek the hospital. Her skin had an ashy, cachectic appearance common to malignant disease. During her stay at the hospital her temperature ranged from 97° F. to 101.3° F., usually registering about 99° F. The pulse rate was continuously high—highest 140, lowest 80, average 116. Respiration: highest 36, lowest 18, average 26.

Urinalysis was negative. Blood analysis showed constantly a polymorphonuclear leucocytosis. At no time during her entire illness was there any symptom complained of that pointed to the genito-urinary sphere. From September 13 the patient sank rapidly. On the day of her death, November 18, 1908, she had two general convulsions, each lasting about two minutes.

Autopsy.—The body presented the usual signs of death; all the superficial lymphatic glands were enlarged, firm, confluent and non-adherent to the skin. Beneath the acromial end of the left clavicle, to the right of the axilla, was a hard lobular tumor mass lying beneath the pectoralis minor about the size of an average orange. This tumor was not connected with either the ribs or pleura. Over the sternal end of the left clavicle was a similar tumor mass.

The abdominal cavity contained about 500 c.c. of clear, pale amber transudate, free from any inflammatory products. The omentum was studded with small grayish white hard nodular masses averaging from 1 to 2 cm. in diameter. The mesentery and mesenteric glands were involved in new growths ranging from a millet seed to 5 and 6 cm. in diameter. The peritoneum was studded with similar tumor masses of various sizes. The stomach, and the intestines, both large and small, were normal. The retroperitoneal glands along the abdominal aorta were extensively involved in metastatic new growths. At the lower pole of the spleen was a metastasis 3.5 x 3.5 x 2.5 cm., sharply outlined from the surrounding territory. In the center of the spleen were similar metastases. *The liver presented no metastases;* it was amyloid. The pancreas was embedded in a mass of enlarged glands which had in some places invaded the pancreas structure. There were no metastases in the pancreas. Uterus and vagina normal. At the fimbriated end of the right tube there was a small metastatic tumor about 4 mm. in circumference. Along the left tube, about 2 cm. from the left horn of the uterus,

was a similar tumor about 3 mm. in diameter. Both pleural cavities contained about 800 c.c. of a pale amber-colored transudate. The pericardial sac contained 120 c.c. of same. The heart was normal except for presence of small degree of fatty degeneration.

Primary Tumor.—The superior third of the anterior mediastinum was entirely filled with a firm resistant tumor mass compressing the base of the heart and the œsophagus. This tumor had involved in its growth the anterior border of the upper lobe of the left lung and the upper half of the pericardium. The tumor mass appeared as though of one growth and not the union of several smaller growths. Section of this tumor mass showed extensive involvement of lung and posteriorly of the bifurcation of the trachea and larger bronchi. The tumor was exquisitely alveolar in structure and very firm in consistency. It was grayish white in color with numerous yellowish areas of fatty degeneration. Several areas had become necrotic. Nowhere could any remains of the thymus gland be found. The deep cervical glands were extensively involved on both sides of the neck.

Cross section of the (secondary metastatic) glandular tumor masses (as the cervical, axillary, posterior mediastinal), showed them to be characteristic of the anterior mediastinal tumor. Over the costal pleura of upper lobe of the left lung, and along the lower margin of the lower lobe were numerous small metastatic growths. At the base of the upper lobe of right lung was a small metastatic tumor. Likewise in the center of this lobe were two metastatic tumors about 1 cm. in diameter. Along the inferior margin of the middle lobe was a fringe of small tumors. The bronchi and bronchioles contained a yellow mucopurulent secretion, and were intensely congested. The upper half of the pericardium anteriorly was firmly adherent to the main tumor of the anterior mediastinum. The epicardium was not involved. Both tonsils and the thyroid were normal. The œsophagus was normal throughout. At its middle third it was greatly compressed by the enlarged mediastinal glands. The larynx and trachea were normal.

Genito-Urinary Tract.—The bladder and urethra were normal. The exits of both ureters into the bladder were normal and measured 5 mm. in circumference. Located 3 cm. from the

bladder end of the right ureter was a sharply defined, circum-scribed, grayish white, firmly resistant tumor oblong in shape 1 cm. x 7 mm. x 5 mm. (*D*, Fig. 1). This tumor was strictly confined to the coats of the ureter, the peritoneal surface not being involved. The mucous membrane of the ureter directly over the tumor was destroyed, being substituted by the tumor structures itself. The mucous membranes on either side of the tumor was normal. The circumference of the ureter immediately below this tumor measured about 7.5 mm. Eighteen mm. above this tumor was a second tumor (*C*, Fig. 1) 2 cm. x 1 cm. x 5 mm., in every respect corresponding to the first one. The circumference of the ureter immediately below this tumor was 8 mm. The circumference immediately above was 17.5 mm. Ten centimeters above this second tumor was a third one (*B*, Fig. 1) 1.5 cm. x 1 cm. x 4 mm., and immediately above this one in immediate proximity, was a fourth tumor measuring about 7 mm. in diameter (*A*, Fig. 1). These latter two tumors in structure and appearance corresponded with the two lower down. The two upper tumors formed considerable of a stricture, the circumference of the ureter immediately below the upper pair of tumors being 2 cm., and immediately above 2.5 cm. The circumference of the ureter at the pelvis of kidney measured 3 cm. The pelvis of kidney was considerably dilated. Its mucous membrane was smooth, glistening and transparent. The mucous membrane of the entire ureter was apparently normal.

The right kidney was very firm in consistency, of a grayish brown color, and measuring 11.5 x 4.5 x 3.5 cm. The capsule stripped readily and surface of kidney was generally smooth. Upon cut surface the cortex measured about 5 mm. in diameter. Markings somewhat effaced. By transmitted light the cortex had a more or less semi-opaque ground-glass appearance. The pyramids showed a like appearance. Located in the capsule were numerous sharply defined grayish white homogeneous tumor masses that in no way involved the kidney structure. At the hilus of the kidney was one such about 1.5 cm. in diameter, but like those on surface of capsule did not extend on to and involve the kidney structure itself.

Located 7 cm. above the bladder end of the left ureter was a tumor 5 x 3 mm., likewise lying strictly within the coats of the ureter and not involving the peritoneal covering, in all respects

FIG. 1.

Fibro-Lympho-Sarcom

A.B.C.D Metastases Right Ureter.
E.F   "   "   Left   "
G. Mouth of Right   "
H.   "   "   Left   "
I. Urethra.
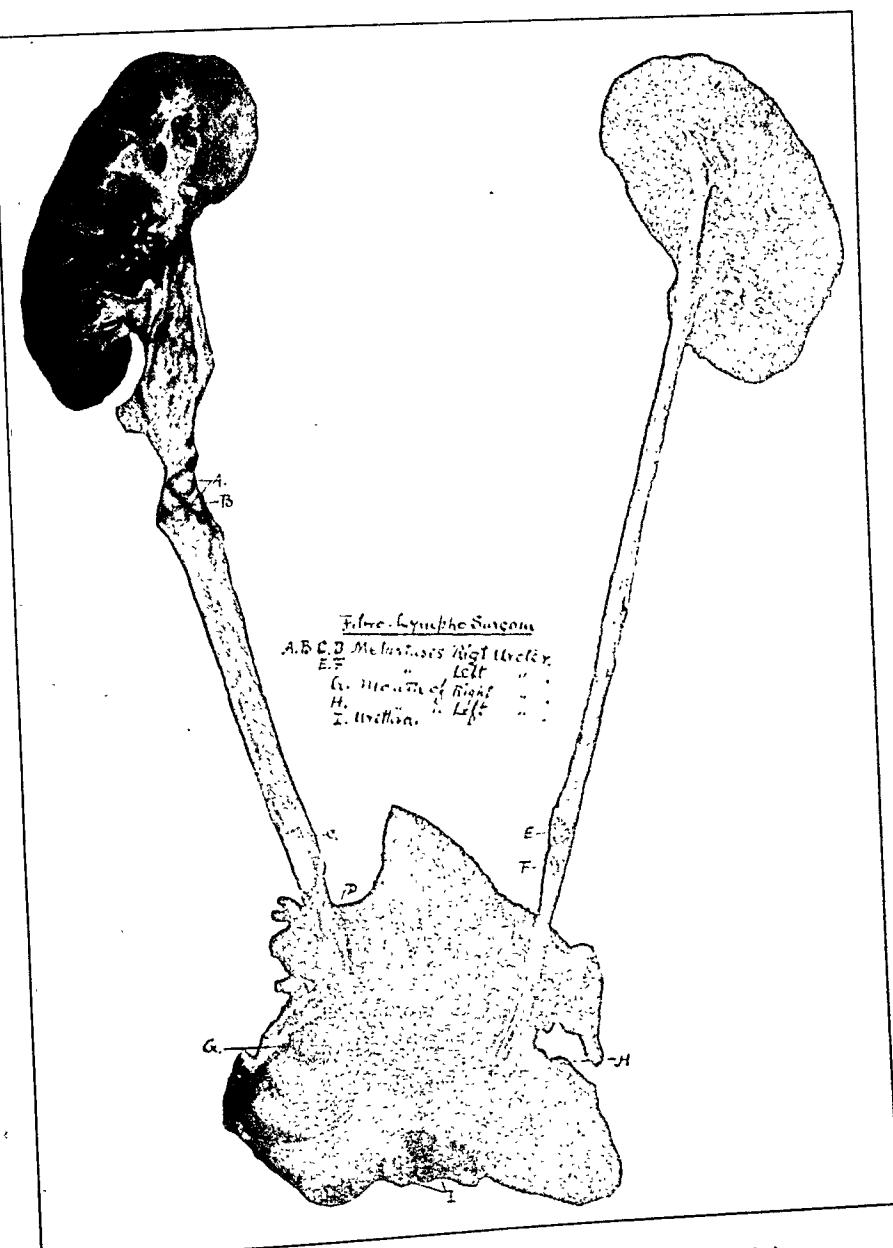
Metastatic sarcomata of both ureters. Reduced one-half natural size.

similar to those of the right ureter (*F*, Fig. 1). Five mm. above this tumor was a second one 1 cm. x 5 mm. of same characteristics as first (*E*, Fig. 1). The circumference of the ureter immediately below the first tumor was 7 mm. The circumference between the two tumors was 1 cm. The circumference immediately above the second tumor was 1 cm., and likewise the same to the pelvis of the kidney which was not dilated and in every respect presented a normal appearance. The left kidney presented about the same characteristics as described for the right kidney. There was no evidence of hydronephrosis. The mucous membrane of the entire left ureter appeared smooth, glistening and transparent.

Diagnosis.—Primary fibrolymphosarcoma of anterior mediastinum, involving left lung and pericardium. Metastatic sarcomas of the cervical, supraclavicular and infraclavicular mesenteric, retroperitoneal and inguinal glands. Metastatic embolic sarcoma of lungs, spleen, fallopian tubes and *ureters*. Amyloid degeneration of liver and kidneys. Chronic bronchitis.

Microscopical Examination.—Microscopical examination of the primary tumor showed evidence of Hassal bodies, thus stamping the origin from the thymus gland. It also showed excess of fibrous connective tissue and mixed sarcomatous cells, large and small round and numerous giant cells, the small lymphoid cells predominating. Eosinophile cells were not present. The same characteristics were present in the metastatic tumors except the absence of Hassal bodies.

There are two striking occurrences in the pathology of this case—one positive and one negative. First, why were there metastatic tumors in the ureters only, and none in the kidneys? and, secondly, why were there no metastatic tumors in the liver when the mesentery and retroperitoneal glands are so extensively involved? The question of the metastases of malignant tumors is an extremely interesting one, and it seems by comparison with other similar pathological studies—as the metastatic abscesses in the cases of pyemia and the secondary growths in the cases of the infective granulomata—that one must accept the truth of the theory of the *predilection of tissues*. Else how are we to explain the frequent occurrence of

metastatic tumors confined to the osseous system following primary malignant tumors of the prostate, or the predilection of the cerebral tissues for metastases of primary fibro-adenomata of the mammary gland? In the case herewith presented it is scarcely probable that no aberrant malignant cells had been brought to the kidneys or liver in a blood stream so enriched thereby. For examination of the capillaries of many of the internal organs shows abundance of metastatic sarcomatous cells.

There seems to be no other explanation of the negative findings in the liver and kidneys in this case other than that these tissues were capable of destroying the malignant cells that undoubtedly had been brought to them. How far the presence of amyloid degeneration in these two organs may have influenced the capability of the aberrant sarcomatous cells to grow therein must at present remain a speculative question.

The author acknowledges his thanks to Mr. Charles Brush for the excellent photograph illustrating this report.

CONGENITAL UNILATERAL ABSENCE OF THE UROGENITAL SYSTEM.

BY DONALD GUTHRIE, M.D.,
Clinical Assistant in St. Mary's Hospital.

AND

BY LOUIS B. WILSON, M.D.,
Pathologist and Director of Laboratories in St. Mary's Hospital, Rochester, Minnesota.

CLINICAL REPORT BY DR. GUTHRIE.—The following case is reported because of its anatomical and surgical interest. There are many cases reported in the literature of congenital anomalies of the female urogenital system involving one or more of its parts, such as imperforate hymen, atresia of the cervix or vagina, unicornate and bicornate uteri, double vaginæ, and, more rarely, the absence of the tube and ovary or kidney and ureter on one side occurring separately or together. Few of these cases have required surgery, except the cases of imperforate hymen, and the atresia of the vagina and cervix, which have been relieved by plastic operations upon the vaginal outlet or the cervix. One anomaly which has been observed, of a somewhat similar nature to the case reported, is a bicornate uterus, one side only of which communicated with the cervix and vagina, with the normal menstruation from that side, while the non-communicating side gradually filled with blood, forming a painful suprapubic tumor of the corresponding side. Five examples of this congenital condition have been operated upon at St. Mary's Hospital. In the majority of the cases reported, the conditions have been found during routine examinations, at operation, or at postmortem, and have been recorded because of their anatomical interest. From the conditions found in this case, we believe that the life of the patient would have been in serious jeopardy had not surgery intervened.

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CASE 28914.—Mrs. P., aged 30. *Family history* negative.

Personal History.—Married two years; has never menstruated, but has had, since 14 years of age, peculiar symptoms at four-week intervals which she has regarded as her periods. These symptoms have been cramping, bearing down pains through the lower abdomen, backache, and headache. There has never been any vicarious bleeding.

Previous Diseases.—Tuberculous arthritis of the right hip when 8 years of age, leaving two inches of shortening and accounting for the deformity the patient presents (Fig. 1).

Present Illness.—Four months ago, at a period when she thought she should have been menstruating, the patient had an attack of severe cramping pain through the lower abdomen, which confined her to bed for one week. At the next period, four weeks later, the cramps returned and were much more severe, followed by tenderness over the whole right half of the abdomen. She was in bed two weeks, and it was at this time the tumor was discovered and operation advised and accepted. A letter from the attending surgeon states that on exploration he found a tumor, which he believed to be the uterus, devoid of attachments on the left side. The right side of the tumor was densely adherent, with attachments as high as the liver. The operation at this time was abandoned for fear of causing the immediate death of the patient. He suggests that the tumor was a deformed uterus filled with retained menstrual blood. The recovery from the operation was good and there were no symptoms until three weeks ago, when the cramping pain returned and has continued, the patient being confined to her bed most of the time since.

Examination.—Poorly-nourished female, short stature. Scoliosis, due to shortening of the right leg. Heart and lungs negative. Tumor palpable in right half of abdomen, extending from symphysis pubis to right costal arch, which is very near the crest of the ilium because of the scoliosis (Fig. 1). Tumor is fixed and tender.

Pelvis: Rudimentary labia majora, labia minora absent. Complete absence of the vagina, urethra easily admits the examining fingers, and a tumor can be felt high up in the pelvis, lying to the right.

Blood: Hæmoglobin 70 per cent.; reds 3,800,000, whites 9,500.

Urine: 1016; alkaline; albumin, trace.   Microscopic: erythrocytes.

Cystoscopic examination by Dr. W. F. Braasch: Urethra dilated, bladder normal size, left meatus absent.   Dr. Braasch suggests the possibility of but one kidney (right).

Diagnosis.—Abdominal tumor—uterus?   Congenital atresia of vagina (absence of left kidney and ureter?).

FIG. 1
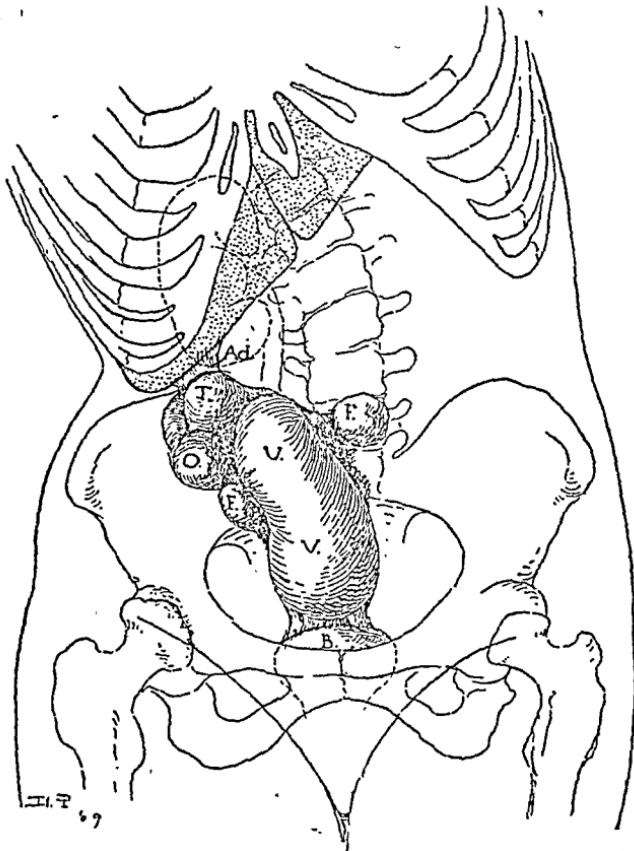
Showing location of tumor.   *U*, uterine portion; *V*, vaginal portion; *T*, fallopian tube; *O*, ovary; *FF*, fibroids; *Ad*, adhesions to liver; *B*, bladder with adhesions to closed end of vagina.   The enlarged right kidney with absence of left kidney and ureter is indicated. Incidentally also the right hip-joint disease and lateral scoliosis are shown.

Operation, January 28, 1909 (W. J. Mayo).—Tumor (Fig. 1), found to be the uterus, 18 cm. long and 9 cm. at its lowest widest portion, adherent below to the bladder and above to the under surface of the liver by adhesions to the right tube, which was distended.   The ovary was cystic.   There was an absence of the tube, ovary and broad ligament on the left side and of the

left kidney and ureter. The tumor was very adherent and removed with difficulty. Recovery was uneventful and a recent letter from the patient says she is enjoying good health.

It was not until the specimen was opened in the laboratory that the true condition of affairs was learned, it being supposed at operation that the whole tumor was uterus and that there was a complete absence of vagina.

Microscopical sections taken from the lower portion of the tumor (Fig. 2) proved the pathologist's belief—that the lower portion of the tumor was the upper portion of the vagina and not cervix—to be correct.

That there should have been a space of 10 cm. between the closed end of the vagina and the perineum is an interesting feature in the case, showing that, originally, only a small part of the vagina was formed and, as the organ grew and filled with blood it followed the line of least resistance and was forced upward into the abdomen.

From the structure of the walls of the tumor it would appear that it had been one of long standing, although the immediate symptoms were acute for the past four or five months.

In a talk with the husband of the patient it was learned that the sexual act per urethram was accomplished at first with very little difficulty, and that coitus had always been gratifying to the patient. There had never been any incontinence of urine, and only a hint of cystitis at one time—six months before the first operation—when there was some frequency of urination, which disappeared after a short time.

PATHOLOGICAL REPORT BY DR. WILSON.—January 28, 1909, there was received in the pathological laboratory from the surgical service of Dr. W. J. Mayo, a specimen from Case No. 28914 the clinical data of which is detailed above by Dr. Guthrie.

The specimen consisted of an irregular ovoid mass 18 cm. in length and 9 cm. in its greatest transverse diameter. External examination showed the tumor to consist of what was apparently a distended uterus with closed cervix, and with but one tube and ovary—the right—attached thereto. Two small fibroids were present, the larger on the dorsal surface and the smaller on the ventral, both attached well toward the fundus. The tube and ovary were bound down to the fundus of the uterus as shown in

FIG. 2

tube

Round Ligament

Fibroid

uterus

vagina

a

b

c

d
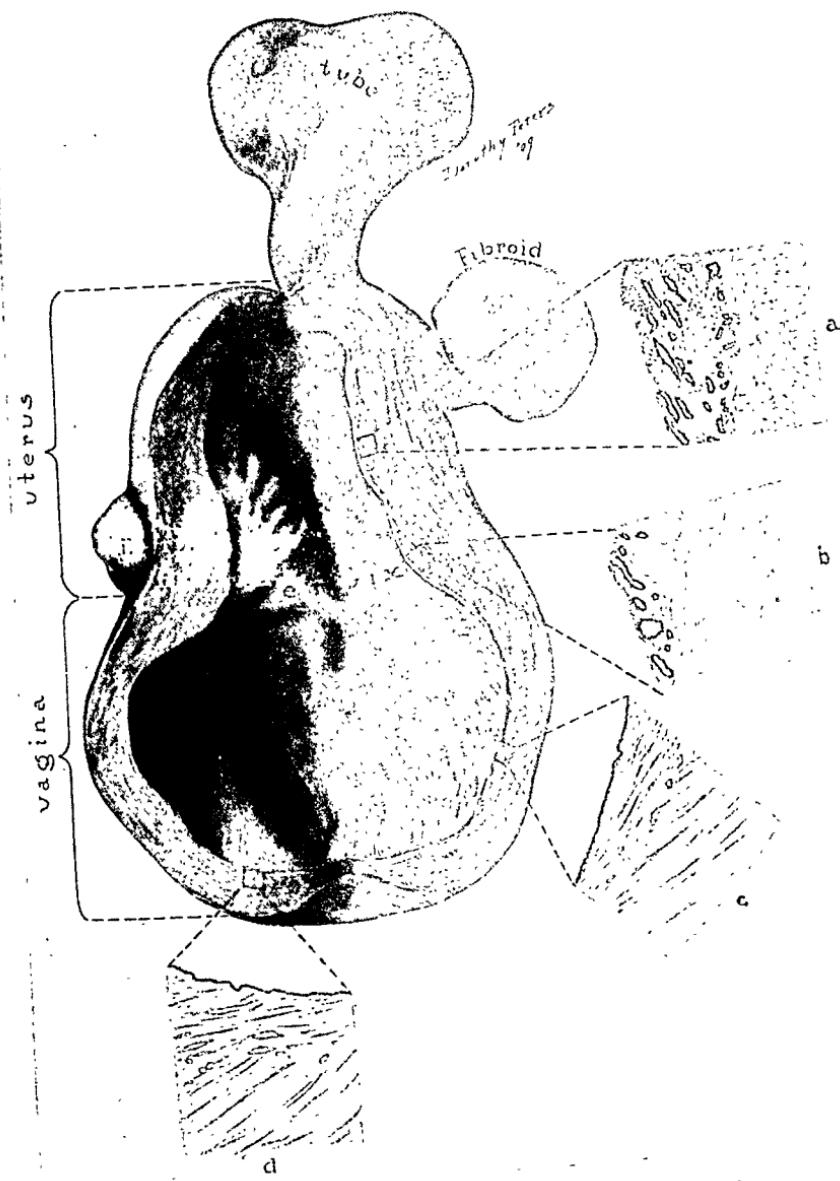
Two-thirds natural size, with sections 10-diameter magnification.
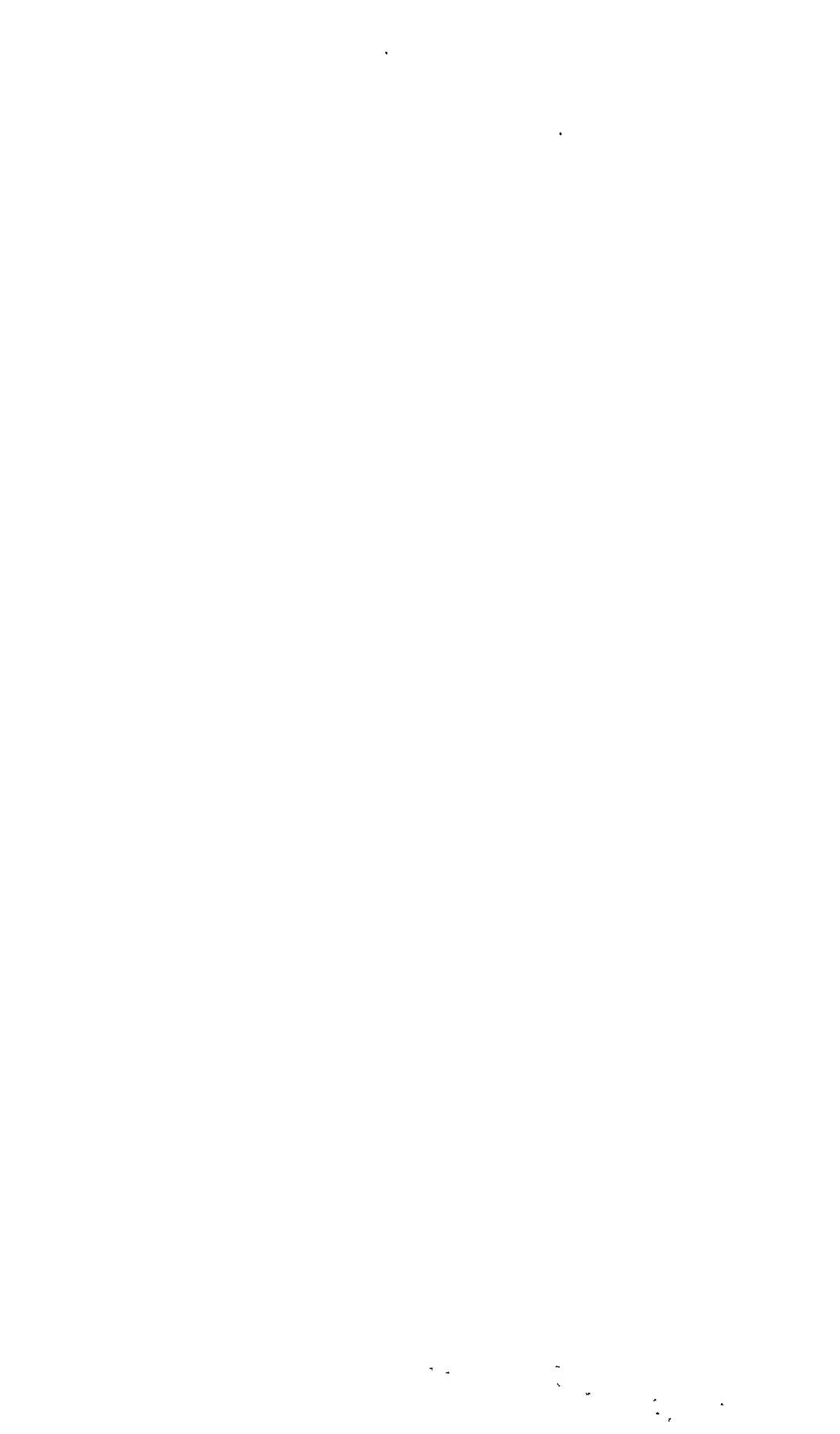
Fig. 1. Both were very much distended. The broad ligament on this side consisted of a contracted mass of adhesions. Numerous remains of adhesions were still attached to the organ, particularly where the fundus and tube had been attached to the liver, and at the lower portion, where attachments had connected it with the bladder. There was no evidence of ovary, tube, or broad ligament on the left side.

The specimen was opened longitudinally on the ventral surface, but well to the right of the median line. It was found to be tensely distended with blood—black, thick, and "tarry." The tube was filled with the same material as were also two or three cysts of the ovary, each of which seemed to be the remains of a much distended corpus luteum.

FIG. 3
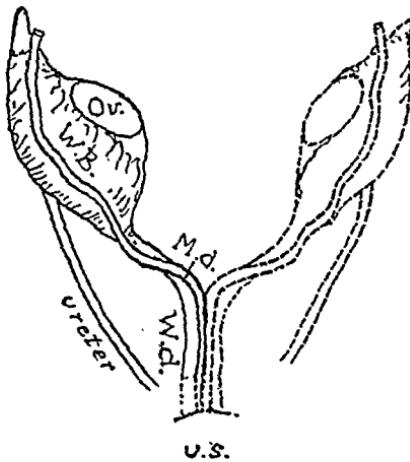
Hypothetical embryological development, early stage. *Ov*, Ovary. *WB*, Wolffian body. *Wd*, Wolffian duct. *Md*, Müllerian duct. *Us*, Urogenital sinus. The dotted portions on the left side and at the lower end of the Müllerian and Wolffian ducts are those portions which are supposed to have remained undeveloped in the present case.

The lower porton of the tumor was more distended than the upper, and its walls were thinner and smoother. The upper half was fairly well marked off from the lower by an indefinite ridge, which suggested an imperfectly formed cervix.

Microscopic examination of the mucosa from the upper portion of the tumor (Fig. 2, *a*, *b*) proved that this portion was uterus with thick walls, lined with tubular mucosa, not very different from that in the normal uterus.

The lower and thinner walled portion showed, microscopically, mucosa (Fig. 2, *c*, *d*) with flattened epithelium, such as is found

in the vagina normally. The walls of the vaginal portion, though thinner than those of the uterine portion, were still enormously thickened, when compared with normal vaginal walls. There was complete absence of the lower end of the vaginal portion.

The specimen would appear, therefore, to be the result of the development of the embryological elements of the right side only, with a destruction of the lower ends of these elements, resulting ·

FIG. 4
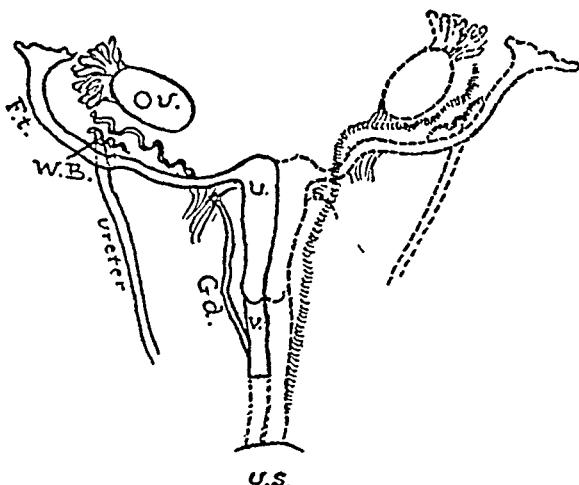
Fig. 4, Hypothetical embryological development, later stage. Parts correspond to those in Fig. 2, except remains of Wolffian duct are designated, *Gd*, Gaetner's duct: *U*, uterus; *V*, vagina.

in a failure of the Müllerian and Wolffian ducts to unite with the urogenital sac. This hypothesis is further explained in the diagrams, Figs. 3 and 4, in which the parts represented by dotted lines are those which probably failed to develop. Such a hypothesis would account also for the absence of the left kidney and ureter. It is difficult to understand why there should have been a failure of the lower portions of the Müllerian and Wolffian ducts to develop, thus leaving the large space, probably 10 cm. between the closed end of the vagina and the perineum. Since the tumor was removed by the suprapubic route there was no opportunity to examine the intervening structures.

PERI-URETERAL PELVIC PHLEBOLITHS.*

BY GEORGE O. CLARK, M.D.,

OF BOSTON, MASS.

IN the Röntgen Congress of 1905 the nature of certain small shadows, varying in number and in size from a shot to larger than a pea, occurring in X-ray plates of the pelvis about the spine of the ischium and the horizontal ramus of the os pubis, was discussed without being definitely settled.[1]

A recent writer claims they occur so frequently that in his six hundred pelvic radiographs of persons over forty years of age, it is the exception not to find some of these shadows.[2]

Similar shadows have been variously explained as being due to artefacts,[5] areas of calcification in the pelvic ligaments,[3] ossifications in the muscles,[1] intestinal concretions and foreign bodies,[6] appendiceal concretions,[7] phleboliths, and many other things. Instances are recorded of diagnoses of ureteral calculus based on such radiograph shadows, but at operation no calculus was found.[4]

M. G. H., autopsy 2207 (September, 1908), furnished a specimen (Fig. 1) which, because of its unusual character, led the writer to a special study of phleboliths, their possible bearing on the above-mentioned question, and their relation to the differential diagnosis of ureteral calculus.

During the last few years, literary contributions to the subject have been many, frequently contradictory, and, I believe, in no single instance comprehensive. To any interested members of the profession who have not the time to sit in judgment on all previous contributions to the literature, and to any others who may doubt the reality of phleboliths or their

ability to cast X-ray shadows, this existing state of confusion may serve the writer as an excuse for submitting this study of what at first sight might appear to be " much ado about nothing."

The writer's specimen consists of the male urinary bladder, ureters, prostate, seminal vesicles, rectum, and tissues immediately connected with the same, removed *en bloc* from a subject whose clinical history (M. G. H., 159,372) contains nothing worthy of note except, " Age, 78 years. Denies venereal disease. Osteomyelitis of left femur of some years duration. Recently, spontaneous fracture of same, necessitating amputation above the knee joint. Later, œdema of the lungs, death." Post mortem were found bronchopneumonia, arteriosclerosis, and the present specimen (Fig. 1).

The bladder is somewhat trabeculated, and, in the region of the trigone, shows evidence of a severe inflammatory process probably long since healed. The periprostatic or rectovesical venous plexus (abyrinthus venosus Santorini) shows bilaterally extensive thrombosis and within the vein lumen in different places eighteen phleboliths (Figs. 2 and 3), the heaviest separate veinstone weighing 150 mgm.

Though exact knowledge of the metamorphosis does not seem to be recorded, phleboliths are defined as having been originally white thrombi in veins which have subsequently undergone calcification,[10] analogous to arterioliths in arteries.[11] Examination of the present specimen accords with this view. In some parts of the plexus the veins are merely thrombosed, elsewhere the lumen is free. The thrombi exist in stages of metamorphosis varying from soft putty-like consistency to practically complete calcification. In other places the vein is represented merely by a string of fibrous tissue.

That portion of the thrombus actually calcified may be properly designated phlebolith,—it is of stony hardness, generally oval or round, but sometimes pear-shaped, of smooth but not always regular surface, yellowish white, and of variable size. Section reveals a grossly, homogeneous construction of alternating, more or less concentric strata enveloping

FIG. I.

Fiq 1. (a)

Prostate

Phleboliths

Ureter

Vas

Areolar tissue

Rectum

Open Vein

(b)
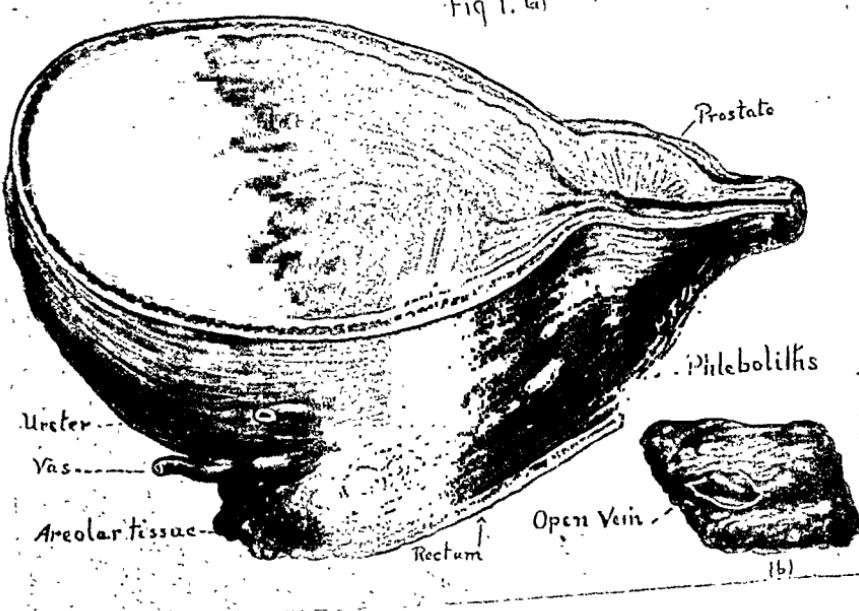
M.G.H., 159372.

Veins containing phleboliths and thrombi, from writer's specimen.
Compare with Fig. 1 b. and Fig. 3.

FIG. 3.
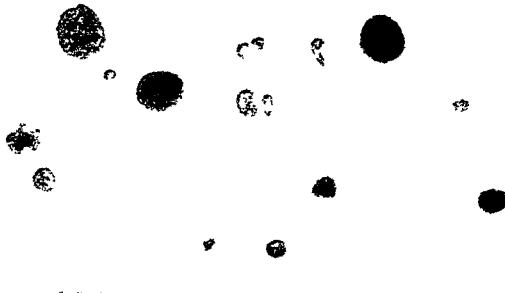
Radiograph of Fig. 2. Note (1) relative atomic density of phleboliths and thrombi; (2) variation in size of phleboliths, in shape, outline, number, lamination. Compare radiographic appearance of phlebolith as actually existing (Fig. 3) with result of radiographing the same clinically (Figs. 4, 5, 6.), where lack of definition occurs.

a central kernel. Surrounding the phlebolith proper, and lightly in contact with or slightly adherent to the vein wall is an ever-present albuminous envelope representing not yet calcified thrombus. Where the vein stone is large this envelope is thin, tough, of yellowish-white color, easily peeled off the vein stone. Elsewhere, it varies in thickness, consistency, and color, so that it is sometimes more properly thrombus plus calcified centre, rather than phlebolith plus envelope.

It would seem that the process of calcification starts about a central nucleus or kernel and proceeds toward the periphery, since the size of the completed products varies from a millet seed upwards and since in no case can be found an outer calcareous shell enveloping an inner softer mass not yet calcified (see Fig. 3). On the contrary, all of the phleboliths have between their surface and the vein wall an albuminoid envelope not yet calcified. In no instance is a phlebolith found lying loose in the tissue, hence they are obviously of intravenous origin.

As late as 1908, a foreign radiographer of experience expressed doubt as to the actual existence of phleboliths, and wonders " why if these so-called phleboliths are responsible for the shadows so frequently met in pelvic radiography, they are not more common in the dissecting room."[2]

Reference to literature shows that the existence of phleboliths has been recognized by pathologists from an early date. They are recorded as having been found most " frequently " around the prostate and bladder in men,[10] in the plexus pampiniformis in women,[10] and in the spleen[14]; not uncommonly in the uterine veins,[5] sometimes in the saphenous veins; also in the mesentery.[6] Exact figures as to frequency of occurrence are wanting. That mention of such occurrence is not oftener made in post mortem records may be due to the pathologist's conviction as to their frequency and intrinsic harmlessness, and to his ignorance that a record of their existence or nonexistence could be of interest to any one. In fact, generally, he probably does not even search for them.

Perhaps this may partly account for the prevailing impression as to their rarity. Since the writer's attention has been directed to this question, he has during the last six months demonstrated the very frequent occurrence of phlebolith about the prostate of autopsied male adults. No instance is reported of phleboliths existing in childhood, nor of shadows in the pelvic radiographs of children attributable to phleboliths.[3]

In 1861, Balogh minutely described the microscopic and chemical examinations of a phlebolith weighing 120 mgm.— one of fourteen found at autopsy in the veins of the posterior bladder wall.[9] The mineral composition was found to be principally carbonates with a small amount of phosphates, calcium oxide, and traces of magnesium and iron oxide. Microscopically appeared corpora amylacea, blood corpuscles, and other cells in various stages of granular degeneration— all entangled in the meshes of coagulated albuminous matter representing the framework of the stony structure. In Balogh's patient malignant disease was the cause of death. This process he erroneously conjectured was the direct cause of the phlebolithic formation.

As to etiology, certainly the process of calcification is preceded by the existence of a nucleus,—in this instance a thrombus; but exactly what determines why one thrombus shall undergo resolution, another organization, and another calcification has not yet been conclusively proven. Pertinent factors predisposing to thrombosis are idiosyncrasy plus local venous circulation of a lowered or impaired degree, congestion, changes in the vessel walls from constitutional disease or from advancing age with its accompanying venous varicosities [16] and arteriosclerosis [18]; also phlebitis [15] and possibly inflammatory processes arising in neighboring structures.

The majority of such factors are conditions very frequently found in the adult pelvis and could account for the common occurrence of phleboliths in this region.

By appropriate bacteriologic technic, drill dust aseptically obtained from the cores of several sizes of vein-stones, separately tested, then planted in blood agar culture tubes and

incubated for forty-eight hours resulted in neither a positive growth nor the discovery of any bacteria in the stained smears obtained from the tubes. As to a possible bacterial etiology of phleboliths, such a result is. unfortunately, of very slight value and only negative at that.

Reports of positive symptoms during life caused by phleboliths *per se* the writer has not found. In fact, it is difficult to believe that such an innocent end-product of thrombosis could in itself cause venous obstruction, ulceration of the vein wall, or even appreciable pressure on a neighboring nerve with consequent irritation.

Nevertheless, these pelvic phleboliths are of very real importance from the chance they afford when present of being mistaken for something else of clinical concern. An intimate acquaintance with their characteristics will be of aid to both surgeon and radiographer, particularly in the interpretation of pelvic radiographs where the question of ureteral calculus arises; for of 30 subjects radiographed post mortem, Mr. Fenwick's radiographer found 8 that showed concretions in the pelvis other than ureteric calculi. In 7 phleboliths were present.[8]

In rectal and vaginal examinations a knowledge of their existence may help to explain some of the indefinite nodules sometimes entering consideration in the differential diagnosis of ureteral calculus, concretions in the bladder, in the prostate, in the seminal vesicles, in the lymph-glands, in peritoneal tuberculosis, other local tuberculosis, and possibly cancer.

In the course of a prostatectomy, either suprapubic or perineal, should some of these phleboliths be encountered, an attempt to worry them out of their vein sheaths could result in no good and would very likely increase hemorrhage.

To ascertain facts as to the actual appearance in a radiograph of phleboliths, the following experiment was done. A male cadaver was obtained and from it removed everything which might be expected to cast a shadow representing any sort of substance not anatomically a normal portion of the bony pelvis. In proper anatomical position was then anchored

en bloc the specimen of bladder, prostate, rectum, seminal vesicles, phleboliths undisturbed as they existed in the vesico-prostatic plexus, and the ureters, each containing a fine metal probe. The pelvis of this cadaver so prepared, and the abdominal incision closed, was then radiographed as if it were a living patient suspected of having ureteral calculus (Figs. 4, 5 and 6).

It proved conclusively that: (1) Experimentally, a phlebolith may cast a shadow in an X-ray plate; (2) Conversely, that clinically, shadows seen in a pelvic radiograph may be caused by the presence in the patient of phleboliths.

Further is to be observed that: (1) The area of their distribution may embrace the pelvic course of the ureters; (2) The number may vary—they are characteristically multiple and bilateral; (3) Where multiplicity occurs, lines drawn on the plate connecting the shadows are apt to give a line at variance with the course of the ureter; (4) The size of the shadows varies from minute to as large as what could cause ureteral obstruction if situated within the ureter (see Fig. 3); (5) Their outline in the clinical radiograph is generally regular and their density even, contrasting with the less definite and generally irregular or angular outline of a true calculus shadow. (The concentric lamination markings of the vein stones as seen in Figure 3 are lost in the clinical radiograph and the appearance of the shadows suggests the comparatively homogeneous chemical consistency of the vein stones (see Fig. 4, 5, 6), in contrast to the frequently varying composition of urinary stones, where the component salts vary and present corresponding variations in the shadow because of the different degrees of atomic density.)

Where, in addition to, or in place of employing Kelly's wax-tipped ureteral bougie, the X-ray is used to further diagnosis, even then casually to diagnose as ureteral calculus a shadow seen in a pelvic radiograph is obviously to invite possible disappointment,[8] as instances of fruitless operations based on such diagnoses are recorded.[4,5]

To state positively the cause of a given radiographic

Fig. 4.

Phlebolith and ureteral indicator fall in the same anteroposterior plane. Compare with Fig. 5.

FIG. 5.

By shifting the X-ray tube the "suspicious" shadow appearing in Fig. 4 is shown to be extra-ureteral.

FIG. 6.

Fig. 5

Retouched. Fig. 6.

Course of Ureter.
Indicated by Stilet.
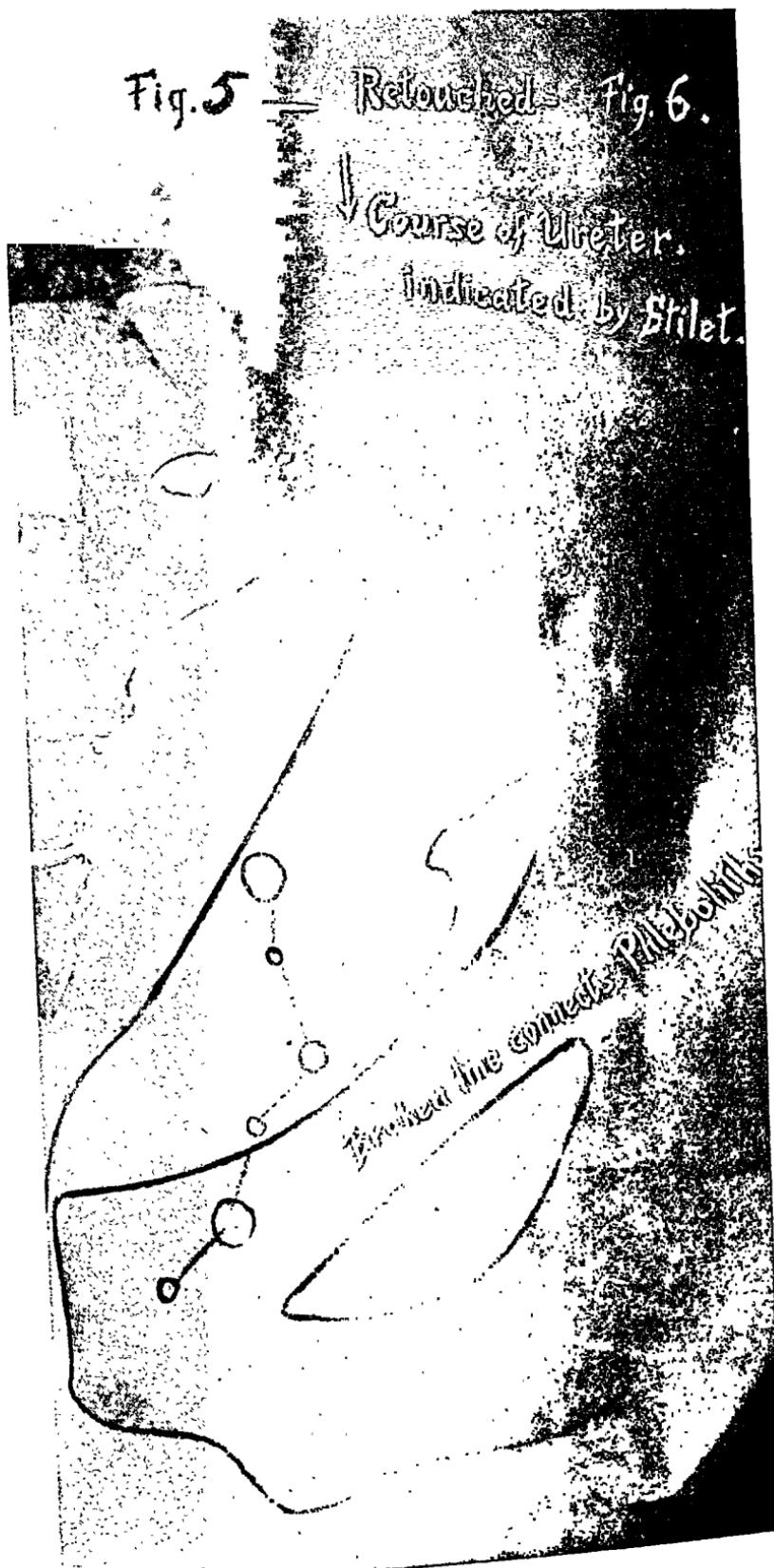
shadow may be very difficult in many cases. Practically, what we primarily seek definitely to establish as regards radiography in a case of suspected ureteral calculus is whether a given shadow is of intra-ureteral origin, or extra-ureteral,—in the latter instance due to any one of many possible causes in themselves perhaps of only academic interest.

Kolischer and Schmidt [17] devised bougies bearing metal cores for insertion in the ureters previous to radiography. Their experiments on the cadaver showed the feasibility of applying this method clinically to ascertain the relationship between a suspicious shadow and the ureteral course as indicated in the radiograph.

Reichman [18] reports the case of a patient suffering from unilateral colic clinically indistinguishable from the ureteral variety. The X-ray plate showed a corresponding shadow, and operation was advised. A radiograph taken after introducing ureteral stiletted bougies showed the suspected shadow to lie 2 cm. outside the ureter's course.

In spite of this technic, it is possible to be misled in case the suspected shadow and that of the bougie lie in the same anteroposterior plane (see Fig. 4). Albers-Schönberg has called attention to this fact and showed a radiographic illustration. In his case the suspected shadow was in reality due to a concretion in the uterine plexus 6 cm. away from the ureter.[1]

To demonstrate the relationship of bougie and suspected shadow in such instances, it has been suggested that the patient or the lamp be shifted to vary the path along which the rays travel through the suspected object to the plate.[3] Stereoscopic radiography has been employed.[8] The effects of shifting the light are seen in Figures 4 and 5.

Caldwell states stereoscopic X-ray plates have proven of little value unless the course of the ureters is outlined by the shadow of the ureteral catheter.[19] With such technic he has demonstrated ureteral calculus to be in contact with the ureteral bougie.

The procedure of introducing ureteral bougies is not without its own peculiar risk. This risk naturally varies depending

on the conditions existing in the patient as well as on the special qualifications of the operator. From the writings of Albarran, Israel, Casper[20] and others,[21] the writer believes that this procedure as employed by experts is attended by no appreciable risk either transitory or lasting. For the technic of ureteral catheterization or bougieing—the indications and contra-indications—the reader is referred to the extensive bibliography chronologically arranged by Ricketts.[22]

Summary.—1. Phleboliths have been recognized by pathologists for centuries as realities.

2. They occur frequently in the periprostatic veins of men and in the plexus pampiniformis of women, varying in size and number.

3. Symptomless in life, and requiring no treatment, they may be discovered only post mortem or in the course of rectal, vaginal, or radiographic examination.

4. In pelvic radiographs they cast small shadows about the spine of the ischium and horizontal ramus of the os pubis, frequently in the course of the pelvic ureter. (*a*) Characteristically, these shadows are multiple and bilateral, but the number and site may vary. (*b*) Frequently the size of birdshot, they may be as large as what could cause ureteral obstruction if intra-ureteral. (*c*) Shape, generally round or oval, may be slightly irregular. (*d*) Density, in contrast to usual ureteral calculus shadows, evenly rendered. (*e*) Where multiple, lines connecting the shadows may show an axis at variance with the ureter's course (Fig. 6).

5. Familiarity with these characteristics will enable the interpreter of a pelvic radiograph to identify, in most cases, certain shadows as being cast by phleboliths.

6. In other cases they may so obscure diagnosis of ureteral calculus that before facts are definitely ascertained it will be necessary to resort to repeated X-ray exposures, varying the relative positions of light, patient, and plate; ureteral bougieing previous to radiography, possibly to stereoscopic X-raying with bougies *in situ*.

7. Suitable technic exists to make certain, without undue

risk, in practically all patients suspected of having calculus in the pelvic ureter the intra-ureteral existence or nonexistence of the substance causing a given shadow.

REFERENCES.

[1] Albers-Schönberg: "Zur Differential-diagnose der Harnleitersteine und der sogenannten Beckenflecken." Fortschritte a.d. Geb. d. Röntgenstrahlen, Bd. 9, S. 255, 1905-1906.

[2] Thurston Holland: Liverpool.

[3] Bevan & Smith: "Diagnosis and Treatment of Kidney-stone." Surgery, Gynæcology arid Obstetrics, vol. vi, p. 683, 1908.

[4] Siredey: "Des erreurs radiographiques dans la recherche des calculs urinaires." La Semaine Médicale, 1906, xxvi, 514.

[5] Orton, G. H.: "Some Fallacies in the X-ray Diagnosis of Renal and Ureteral Calculi." Brit. Med. Journ., 1908, ii, 716.

[6] Leonard, C. L.: "The Röntgen Method in the Diagnosis of Renal and Ureteral Calculi." Med. News, 1902, lxxx, 305.

[7] Weisflog: "Zur röntgenographischen Diagnose der Enterolithen des Proc. vermiformis." Fortschritte a.d. Geb. de Röntgenstrahlen, Bd. 10, S. 217, 1906-1907.

[8] Fenwick, E. Hurry: The Value of Radiography in the Diagnosis of Urinary Stone. Churchill, London, 1908.

[9] Balogh, Colomann: Virchow Archiv, vol. xxii, p. 187, 1861.

[10] Welch, W. H.: In Allbutt's "A System of Medicine," vol. vi, p. 165, 1899.

[11] Ziegler: General Pathology, ninth ed., p. 123.

[14] Canstatt: Pathologie u. Therapie, second ed., vol. iv, p. 732, 1843.

[15] Rokitansky, C.: Lehrbuch d. Pathologischen Anatomie, third ed., Bd. ii, S. 357, Wien, 1856.

[16] Lenhossek: Das Venose Convolut der Beckenhöhle beim Manne, 1871.

[17] Kolischer, G. and Schmidt, L. E.: "New Method in Skiagraphic Diagnosis for Renal and Ureteral Surgery." Journ. Amer. Med. Asso., 1901, vol. xxxvii, p. 1228.

[18] Reichman, M.: Shadows in Röntgen Negatives which might be mistaken for Ureteral Calculus, Chicago.

[19] Caldwell, E. W.: "Röntgen Ray Diagnosis of Urinary Calculus." Bos. Med. and Surg. Journ., 1908, clviii, p. 120.

[20] Casper, L.: Handbuch der Cystoskopie, p. 198, Leipzig, 1905.

[21] Elsner, S. L.: "The Diagnostic Value of Ureteral Catheterization." Journ. Amer. Med. Asso., vol. lii, p. 1168, 1909.

[22] Ricketts, B. M.: "Surgery of the Ureter," Cincinnati, 1908.

CYST OF THE PROSTATIC URETHRA.

BY LEO BUERGER, M.D.,

Associate in Surgical Pathology, and Assistant Adjunct Surgeon, Mount Sinai Hospital,

AND

ADELE OPPENHEIMER, M.A.,

Volunteer in Surgical Pathology, Mount Sinai Hospital, New York.

In the course of a histological and anatomical study of the posterior urethra, we recently encountered a specimen of prostatic cyst, or cyst of the prostatic urethra, which, because of its rarity, deserves a short mention. It was found at autopsy in a man, 38 years of age, who had died of peritonitis.

Situated about 8 millimeters below the margin of the internal sphincter, on the left side and at the junction of the anterosuperior with the posteroinferior urethral wall, we found a tense cystic body, projecting into the lumen of the urethra. Its hemispherical surface was formed by extremely thin glistening mucous membrane, which by virtue of the color of the fluid content gave a greenish yellow sheen. The cyst measured about 6 millimeters in diameter, its highest point being elevated about one-half a centimeter above the level of the surrounding mucosa. Just medial to it, a few tiny pinhead-sized glistening points indicated the presence of similar but much smaller fluid collections. At a corresponding site on the right side there were the beginnings of minute cyst formations. None of these lesions were placed in the region of the openings of the prostatic ducts, but a fair distance above (cephalad) and to the outer side of these.

Upon opening the thinned wall of the cyst, thick, mucoid, green-yellow fluid escaped. A close inspection of the cavity thus exposed revealed the fact that the intraprostatic extent was far less than was indicated by the intra-urethral protrusion, the cyst having developed towards the mucosa rather than into the denser connective and muscular tissues of the prostate. The fluid was found to contain a very few cellular elements in the shape of desquamated, degenerated epithelial cells, and some granular detritus. There were no corpora amylacea.

Fig. 1.
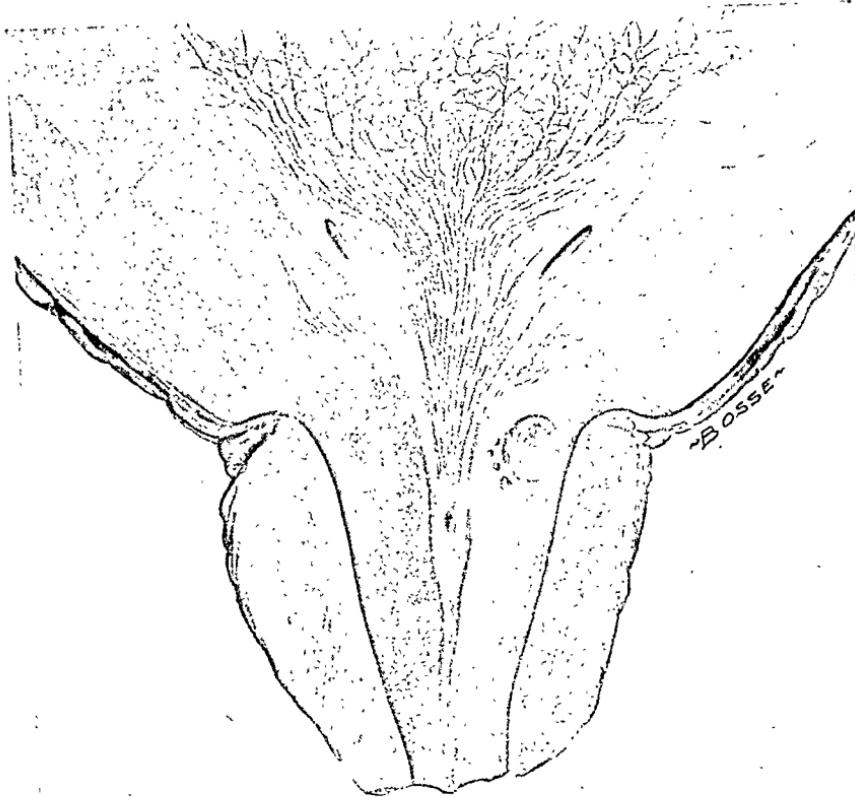
Prostatic urethra opened anteriorly, exposing the large cyst near the vesical sphincter.

FIG. 2.

The irregular bay in the upper left-hand part of the photograph repre-
sents a portion of the deep wall of the large cyst.

FIG. 3.

Section showing one of the smaller cysts.

In Fig. 2 * a small portion of the opened and very much shrunken prostatic wall of the cyst is shown. It is lined by two to three layers of compressed epithelium, and has apparently had its beginning in the subepithelial layers of the prostatic urethra. Its growth into the prostate is very slight, and its extension has occurred mainly in directions parallel with the mucous membrane, the central portion of which has been lifted up in the lenticular manner depicted in Fig. 1. The intraprostatic portions of one of the smaller cysts is to be seen in Fig. 3.

A review of the literature bearing on this subject has convinced us that in our specimen the location of the cyst is unique. Although Morgagni had already mentioned the occurrence of cysts in the prostate, these must be rather uncommon, for, excepting those that are the results of retention in the hypertrophic organ, very few cases with accurate pathological descriptions have been recorded. Englisch found that closure of the orifice leading into the sinus pocularis not infrequently gives rise to retention cysts in the new-born, that micturition may be prevented by obstruction to the vesical outlet, but that spontaneous cure usually takes place on the second or third day of life, by reason of the rupture of the cyst. Springer has reported that this lesion of the utriculus is found in the adult and he describes three such cases and a fourth in a boy of one year and nine months old.

A rarer site is the *pars supramontana*. Englisch saw a hemispherical tumor about 1½ centimetres in diameter just at the middle of the posterior half of the internal sphincter, and attributes its formation to dilatation of aberrant prostatic glands. Socin and Burckhardt were able to diagnosticate a similar tumor with the cystoscope, and removed it successfully. They also record the finding of a cyst of the prostatic urethra at autopsy of a man, 59 years of age who never had any urinary symptoms. The tumor is said to have been situated on the right side of the posterior wall of the vesical neck, was about the size of a pea, and contained clear serous fluid.

* The photomicrographs were prepared by Dr. F. S. Mandlebaum, director of the Mount Sinai Pathological Laboratory.

In our case we are dealing with a small retention cyst evidently arising from glands of the prostatic urethra in a part of the canal that is normally sparsely supplied with glandular elements. The dilatation in the immediate vicinity of the larger cyst, and the similar changes on the opposed wall, point to the existence of glands that may be regarded either as abnormal prostatic or enlarged glands of the urethral mucosa.

It is unfortunate that we were unable to obtain data that might have enlightened us as to whether the lesion had caused any symptoms. Nevertheless, it is clinically of interest to note the possibility of the presence of such cysts, and to theorize as to the manifestations that these could produce either by rupture or by interference with the normal action of the vesical sphincter.

LITERATURE.

Aschoff, L.: Virchow's Archiv, 1894, vol. cxxxviii, pp. 119, 195.

Englisch: Ueber den Verschluss des Sinus pocularis, Jahrb. d. k. k. Gesellsch. d. Aerzte in Wien, 1873, i, p. 61. Ueber Zysten an der hinteren Blasenwand bei Mannern, *ibid*, 1874.

v. Frisch and Zuckerkandl: Handb. der Urologie, 1906, iii, p. 641.

Morgagni: De Sedibus et Causis Morborum, 1761. Venetiis, Forty-fourth Letter, p. 386.

Planty-Mauxion: Des Kystes de la Prostate. Thèse de Paris, 1878, No. 127.

Socin-Burckhardt: Deutsche Chirurgie, 1902, vol. liii, p. 365.

Springer: Zur Kenntniss d. Zystenbildung aus dem Utriculus prostaticus. Zeitschrift f. Heilkunde, 1898, p. 459.

Thorel: v. Bruns, Beiträge zur klin. Chir., xxxvi, p. 630.

INTERILIO-ABDOMINAL AMPUTATION.

BY JOSEPH RANSOHOFF, M.D., F.R.C.S. (Eng.),

OF CINCINNATI, OHIO.

My reasons for presenting this paper are that the case report which gives it foundation is the third of its kind to be recorded in the United States, and I feel justified in counting it among the operative successes. Had Billroth's interilio-abdominal amputation performed in 1891 been a success, it is quite certain that it would not have remained unknown for eleven years, to be recorded finally on verbal testimony alone. If a name is to be attached to the operation it should be that of Jaboulay of Lyons, who in three years had three opportunities of performing it. He reported no successful operation, and only one of his cases survived the fourth day.

The case which I beg to report is the following.

James F., colored, æt. 45. Was admitted to the Cincinnati Hospital September 29, 1908. The family history is negative. There is a history of an initial lesion twenty years ago, and of repeated attacks of gonorrhœa. Six years ago the patient was kicked in the right hip by a mule. Three years later he noticed a swelling in the right groin, which, gradually increasing in size, caused a swelling of the foot and leg. He entered the hospital the first time February 18, 1908, for this swelling in the groin.

Examination on admission showed the patient to be normal, save for the inguinal swelling and the œdema of the leg. The swelling in the inguinal region was the size of two fists, very hard and attached to the ilium. The tumor was painless. The femoral vessels were displaced forwards. On the inner side there were several distinct and isolated inguinal glands about the size of a pigeon egg. Hip movements at this time were not impaired except in abduction. The entire extremity was œdematous.

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On February 24, 1908, the bony tumor was removed by Dr. E. W. Walker. The laboratory report showed the tumor to consist of cancellous bone with no evidence of malignancy, but a slight round-celled inflammatory infiltration into a portion of it. Recovery from this operation was seemingly complete. The result was good and the patient left the house May 2, 1908; has been at work at common labor until two weeks ago, September 12, 1908, when an abscess in the region of the former tumor ruptured. The discharge has been very free ever since.

Status Præsens: September 29, 1908. Head, neck, chest, and abdominal examinations negative. The right leg much larger than normal, from œdema. Little or no motion in the hip joint. Bony proliferations are felt on the right pelvis and the upper part of the shaft of the femur, and about the trochanter. There is a fluctuating painless mass on the inner side of the ankle. A sinus at the site of the former operation leads to exposed bone. It radiates in various directions. Pus channels have been formed all along the anterior part of the thigh. The general condition of the patient is not good; his appetite is poor, the pulse rate is fast and there are irregular elevations of temperature. The patient is septic.

On October 5, 1908, a long incision was made on the front of the thigh for drainage, and a large piece of necrotic bone removed. From this time on the wounds were irrigated two or three times a day and packed with gauze. From time to time the local treatment varied, iodoform and bismuth injections being used. The patient's condition failed to improve, the discharge continuing very free and foul.

X-rays taken of the patient show a tumor the size of a fist, involving the iliac bone, the upper end of the femur and the tuberosity of the ischium.

December 28, 1908. The wound was enlarged under local anæsthesia and curetted for better drainage. Before this was done, an amputation was highly recommended to the patient, but he refused. From this time forth a typical septic course continued.

From day to day the evening temperature rose from one and a half to three degrees; the pulse fluctuated between 90 and 110; night sweats were frequent and the patient was bedridden. From a number of sinuses on the anterior and outer portions of

the thigh and gluteal regions large quantities of pus were being discharged, notwithstanding the use of frequent irrigations. It was in this condition that as a last resort an interilio-abdominal amputation was done.

Operation, March 8, 1909. Ether anæsthesia. Esmarch bandage applied to the entire leg to preserve its blood for the patient. The right common iliac artery was next tied through a median abdominal incision. On account of the numerous sinuses in the region of the trochanter and over the gluteal mass, it was possible only to make use of an internal flap. The first incision was made a little below the crest of the ilium and Poupart's ligament, from the posterior superior iliac spine to the centre of the ligament. The incision was continued through the various layers of soft parts until the fascia transversalis was reached. In doing this a number of sinuses with exceedingly indurated walls and dense cicatricial tissue were cut through. Nevertheless, the fascia and underlying peritoneum were reflected without opening the abdominal cavity until the brim of the true pelvis was exposed for nearly its entire length on the side affected. The next step of the operation consisted of making the long internal flap, the incision beginning at the centre of Poupart's ligament and coursing down the anterior surface of the thigh and terminating with a long curve in the posterior incision which terminated above at the point of starting. This long internal flap was quickly dissected from the surface of the femur with very little bleeding. With a very broad chisel the iliac bone was next divided in front of the sacro-iliac joint, the cut being rapidly made from the crest to the sciatic notch. An inch to the outer side of the symphysis the chisel was next applied and driven to the thyroid foramen. It was similarly used to cut through between the ischium and pubes. I am sure that the use of the chisel greatly shortened the time of the operation. On the other hand, the forceful blows necessary to cut through the bone were associated with shock, as evidenced by the rapid fall of blood pressure. At this time an intravenous transfusion of normal salt solution, for which preparation had been made, was given. The removal of the lower extremity with the resected part of the iliac bone in one piece was then very quickly accomplished with a few strokes of the knife. During the operation the patient did not loose more than a few ounces of blood, and most of this, strange

as it may seem, came from the femoral artery when it was divided. Doubtless the anastomotic circulation with the other side had been very free. I have recently seen the same free bleeding from a divided femoral artery immediately after the common iliac was tied. We encountered no enlarged glands in the operation. The wound was closed with buried muscular sutures and ample drainage for the many and irregular sinuses and thick walled pus cavities encountered in the course of the operation. The patient left the operating table in very fair condition.

The subsequent history was that of a continuous and unequal struggle with the sepsis present before the operation. As has occurred so often where the long internal flap was used, gangrene of the wound margins developed in two or three days and necessitated removal of many of the sutures. The repair power of the patient was at a minimum. The use of streptolytic serum especially prepared failed to make any impression on the septic condition. An enterocolitis, septic in character, developed four weeks after the operation and could not be controlled.

The autopsy revealed caseating pulmonary tuberculosis, acute toxic nephritis, myocardial degeneration, and advanced fatty degeneration of the liver. The clot in the common femoral was well organized. The wound in the peritoneum over the artery where it was tied could scarcely be found.

An examination of the specimen which I beg to present and of which I submit X-ray plates, showed it to be, in my judgment, an osteosarcoma (Fig. 1).

The following is the report of Dr. Marion Whitacre.

Specimen presented for examination consisted of upper end of femur, the hip joint and a part of the pelvis.

After removing the soft parts, the tumor mass seemed to be very hard, not bony hard, as the surface seemed to be made up of a dense tissue almost of a cartilaginous tissue. There were sinuses extending into the growth at various places from which a purulent fluid ran when the packing was removed.

Small pieces were taken from various parts of the growth in the soft parts above mentioned for microscopic examination, the report of which will follow. The tumor mass was then sawed in two, the endeavor being to pass through the head of the bone and at same time get a good view of the tumor growth. Small pieces of bone were taken at different places for examination.

FIG. 1.

X-ray plate. Osteosarcoma of pelvis.

The specimen gave the appearance of being a hard osteoma surrounded by a large amount of chronic inflammatory matter.

MICROSCOPIC EXAMINATION.—The sections of the hard fibrous tissue were made up of a large amount of dense connective tissue with considerable evidence of degeneration in places. Other places showed a rather vascular condition with considerable evidence of acute inflammation in the presence of leukocytes throughout the tissues. At one or two places the sections showed distinct evidence of sarcomatous growth in the presence of large number of round and spindle cells. The bloodvessel walls were very poorly formed, many of them being made up of the cells of the tumor. There was also evidence of capillary hemorrhage in places.

The bony section after decalcification showed for the most part a hard cancellous bony growth, but on one side showed evidence of the invasion of the sarcomatous elements. The trabeculæ of the bone were invaded by a connective tissue growth, which were of the spindle shape.

From the examination, I should be inclined to think that the growth was originally an osteoma surrounded by a considerable area of inflammatory tissue, and that the mass on one side had undergone a malignant change and this had also invaded the bone, thus giving the diagnosis of osteosarcoma.

The indications for interilio-abdominal amputation have thus far been neoplasms of the upper end of the femur and of the pelvis and intractable tuberculous coxitis involving the acetabulum and iliac pan. In regard to prognosis these cases should be separately classed according to the nature of the disease, whether tumor or tuberculosis. A further division should be made between the operation done in one stage and those in which after a varying interval the amputation at the hip is followed by a more or less extensive resection of the innominate bone. I have endeavored in the following tables to record all of the operations hitherto published. Of the total number, thirty-four cases, nineteen were tabulated by Keen and Dacosta in 1904.

TABLES.

It will be seen from Table No. 1 that the postoperative mortality of this amputation " the most extensive operation in all the realm of surgery," is 68 per cent., counting the cases of death after twenty days with the operative recoveries. In this I have followed the lead of Keen. In the cases where

the resection of the pelvis was preceded by amputation at the hip, no deaths followed the second operation. From this it might be inferred that this course is preferable as a routine procedure. Unfortunately, in tumors of the pelvis, the two-stage operation is not feasible, and in those for tuberculosis none other is ordinarily applicable. In the case recorded by Freeman, the amputation at the hip was immediately followed by resection of the pelvis. The extent of the disease was evidently not apparent until the hip-joint amputation had been done. In the cases of Girard and Pringle the second operations were made for recurrent disease after disarticulation at the hip.

Doleful as are the immediate results of interilio-abdominal amputation, the end results have been even more unpromising. The cases of Girard classed with recoveries, died within six months of recurrence. Pringle's case died in five months with metastases. Salistcheff's case was reported well within four months of the operation. The end result I do not know. The record case is probably that of Freeman. Although he left the anterior third of the acetabulum and of the ilium, the case belongs in the category of interileo-abdominal amputation. Freeman's case was well at the end of sixteen months when reported, but died twenty months after operation from recurrence in the abdominal wall (personal communication). Of the end results of the operation for tuberculosis, the data are extremely meagre. The case of Bardenheuer gained in health and strength four months after the operation, and it is presumed was a permanent recovery. The case of Pringle was without recurrence seven years after the operation.

In the face of these unpromising results, it may be questioned whether the operation is justified. The same question has been put for every major operation in surgery, and has in the course of time with unvarying uniformity been answered affirmatively. By limiting the operation to suitable cases and performing it at a time when there is at least a probability that the patient can bear the shock connected therewith, it is almost certain that the prognosis will improve as it has so

markedly for amputation at the hip. Disseminating the knowledge that the operation is feasible will, by bringing the cases earlier to the surgeon, contribute much towards this desirable end. With two exceptions, I know of no text-book in which the operation is even mentioned.

In an operation of such magnitude, the initial mortality is largely due to hemorrhage and to shock. Of all the cases that are not included under postoperative recoveries, only two survived the fourth day. The prevention of hemorrhage has in most of the cases been sought by preliminary tying of the common iliac, the internal iliac or the external iliac. Many believe that the tying of the corresponding veins ought always be practiced. Kocher and Kadjan encountered severe venous bleeding. Tying of the thin-walled large veins doubtless would increase the difficulties of the operation. Faure, after a median laparotomy, applied a temporary ligature to the aorta just below the common iliac. Nevertheless, a severe venous hemorrhage from subcutaneous and subperitoneal veins necessitated abandonment of the operation. Nanu, Jaboulay, Cacciopoli, and Salistcheff also ligated the common iliac. Bardenheuer tied both the external and the internal iliac vessels. Freeman tied the external iliac and, later in the operation, the common iliac. Keen tied the internal iliac artery. That by the tying of the common iliac artery preventive hæmostasis can be accomplished, has been amply demonstrated in the case reported, and it was most satisfactory. Unfortunately where a long internal flap is, as in our case, a matter of necessity, there is great danger of gangrene. This had already commenced in Keen's case, although the patient lived only thirty-three hours. The gangrene strangely developed in the superior flap and not in the margin of the long internal. In my case the gangrene involved the long flap only. Were a similar case to come under my observation, I would tie the external iliac and the posterior trunk of the internal. In that manner the obturator artery would be left intact for the nutrition of the long internal flap.

What promises to be a decided addition to our methods of

preventive hæmostasis is the method of Momburg. He encircles the abdomen below the costal border with three or four turns of a tourniquet, thereby controlling the circulation through the aorta itself. It seems that in the cases thus far cared for in this manner no harm has come to the viscera. It would seem, however, that the placing of the strap in such close proximity to the wound margin might make one feel that it would slip after the amputation is completed. This objection, it must be confessed, is a theoretical one on my part. It has been answered by a successful operation done by Bier, where the strap was kept in place for eighteen minutes.

The prevention of shock is a further desideratum. In our case there was no manifestation of shock until the chisel was used. While the use of the chain or wire saw may minimize this shock, it cannot in this way be entirely overcome. In a future case I should attempt the operation under spinal anæsthesia, which method was used by both Bier and Pringle with success. At all events, I should use the lumbar anæsthesia in conjunction with the general.

In regard to the amputation proper, there comes the question as to the extent of the pelvic bone to be removed. In the earlier cases the entire innominate bone from synchondrosis to symphysis was removed. One should be guided in this matter by the extent and site of the disease for which the operation is performed. Most of the primary tumors of the innominata spring from the iliac pan or the tuberosity of the ischium. Where it is possible, the ramus of the pubes and of the ischium should be left, since they give attachment to the rectus muscle and the corpus cavernosum. The likelihood of a hernia would be lessened.

In regard to the method of operating, writers differ. Where it is possible, a disarticulation at the hip may with advantage, as was done by Bardenheuer and Freeman, immediately precede the resection of the pelvis. A glance at the X-ray plate of the specimen removed in my case, shows that this procedure would have been unfeasible. This is true probably of the majority of cases of sarcoma springing from

the pelvis. In this regard, as in that of securing adequate flaps for covering the extensive wound, every case must be considered on its own merits. This is doubtless the reason why so many methods have been devised for the interilio-abdominal amputation.

The original operation of Jaboulay consisted of making one large posterior flap. The first incision was made from the symphysis parallel to and over Poupart's ligament and the entire length of the iliac crest. By retracting the upper wound margins the soft parts are lifted from the iliac fossa and the vessels easily reached for tying. A circular incision is next made at the upper third of the thigh, through the centre of which on the anterior surface the two incisions diverge towards the pubes and the iliac crest. Thus a very large posterior flap is left which completely and easily covers the wound.

Girard operated in three cases by making internal and posterior flaps. Bardenheuer formed external and internal flaps, and Salistcheff in his successful case operated by the racquet method. He begins his incision below the twelfth rib and passes over the anterior superior spine of the ilium to Poupart's ligament, which it follows to the pubes. Through this incision the vessels are secured. The wide end of the racquet incision sweeps over the internal surface and back of the thigh and over the buttock to the point of starting. The simplest method, from an operative standpoint, is that of the long internal flap, the method of Savariaud slightly modified by Keen and adopted by me. It has the signal disadvantage of having to be exceedingly long to cover the wound. The risks of gangrene I believe to be larger after this operation than after any other. Where it is feasible, it appears to me that the incision of Salistcheff has superior advantages.

Interilio-abdominal amputation must always remain a desperate operation. It should never be resorted to where a less mutilating procedure is possible. Partial resection of the os innominatum for tumors of the iliac pan ought to be per-

formed in preference to the interilio-abdominal amputation. Strange as it may seem, the three complete hemipelvic resections performed by Kocher (2) and Roux (1) all recovered. Whereas according to Croisier, of the partial resections there were eight deaths and seven operative recoveries. It is needless to add that these conservative operations have a place only for limited neoplasms. So far as the usefulness of the ilium is concerned in hemiresection of the pelvis, there has been less impairment of stability and usefulness than one might imagine. In the cases of interilio amputation that have survived, there has been no tendency towards eventration, a condition which one would judge to be a certainty after removing so much of the bony support of the abdominal viscera.

TABLE I.—OPERATIONS IN ONE STAGE FOR SARCOMA.

1. Billroth (1891). Death in a few hours. Verbal communication, Savariaud, Rev. de Chir., vol. xxvi, p. 350.
2. Jaboulay (1894). Death in 36 hours. Lyon Méd., 1894, p. 507.
3. Jaboulay (1895). Death in 24 hours. Province Méd., 1896 (Pringle).
4. Jaboulay (1895). Death in 5 days. Girard, verbal communication (Pringle).
5. Cacciopoli (1894). Death in 3 hours. Cent. f. Chir. (quoted), 1894, p. 988.
6. Gayet (1895). Death in 1 hour. Province Méd., 1894, No. xxxv.
7. Girard (1895). Recovery. Congrès Chirurg., 1898.
8. Faure (1899). Operation abandoned. Savariaud, Rev. de Chir., vol. xxvi, p. 365.
9. Freeman (1899). Recovery. ANNALS OF SURGERY, vol. xxxiii, p. 318.
10. Nanu (1900). Recovered from operation; gangrene of other leg. Congrès Internat., Paris, 1900.
11. Salistcheff (1900). Recovery. Archiv. f. klin. Chir., vol. lx, p. 57.
12. Savariaud (1901). Death in 2 hours. Rev. de Chir., vol. xxvi, p. 360.
13. Gallat (1901). Death in 1 hour. Annal. de Chir. (Belge), vol. ix, p. 569.
14. Morestin (1902). Death in 9 hours. Bulletin Arch. Gen., 1903, vol. cxii, p. 1665.
15. DeRuyter (1902). Death in an hour. Henri Myer, Inaug. Thesis, Leipzig, 1902.
16. Keen and DaCosta (1903). Death in 33 hours. Internat. Clinics, vol. iv, Series 13.
17. Kadjan (1903). Death on 2nd day. Yahresbericht f. Chir., 1902, p. 1104.
18. Kocher (1903). Death on 2nd day. Yahresbericht f. Chir., 902, p. 603.

19. Lastaria (1907). Died on table. Reforma Med., Napoli, vol. v, p. 457.
20. Orlow (1901). Lived 35 days. Yahresbericht f. Chir., 1902, p. 1104.
21. Bier (1908).* Recovery. Momburg, Centblt. f. Chir., 1908, p. 657.
22. Ransohoff (1909). Recovery. Lived 38 days.

* In a personal communication Professor Bier informs me that his patient died two months after operation, of recurrence in the abdominal wall.

TABLE II.—OPERATIONS IN TWO STAGES FOR SARCOMA.

1. Girard (1895). Amputation at hip. Some months later resection of pelvis. Recovery. Rev. de Chir., vol. xxvi, p. 365.
2. Pringle (1908). Amputation at hip. Death 6 months after resection of os innominatum. Lancet, Feb. 20, 1909.

TABLE III.—AMPUTATIONS FOR TUBERCULOSIS.*

1. Girard (1895). Died in 50 minutes. Rev. de Chir., 1898, p. 1141.
2. Bardenheuer (1897). Recovery. Gesellsch. d. Chir., xxvi, l, p. 130.
3. Gallet (1900). Died in six hours. Gesellsch. d. Chir., xxvi, 1, p. 130.
4. Ribera (Madrid) (1902). Died, collapse. Luis y Simon, Siglo Med., 1903, vol. v.
5. Ribera (1902). Died 8th day. Luis y Simon, Siglo Med., 1903, vol. v.
6. Ribera (1902). Died, collapse. Luis y Simon, Siglo Med., 1903, vol. v.
7. H. Vermeuil (1905). Died in 2 hours. Jour. de Chir. (Belge), vol. v, p. 406.
8. Morestin (1908). Recovery. Bull. Soc. de Chir., Paris, vol. xxxiv, p. 1060.
9. Pringle (1908). Recovery. Lancet, Feb. 20, 1909.
10. Pringle (1908). Death on 1st day. Lancet, Feb. 20, 1909.

* The operations for tuberculosis were practically all done in two stages, the first being either a hip resection or amputation. The extent of the resection of the pelvic bone varies much. I have, however, excluded all cases in which the resection did not involve the major part of the ilium.

A NEW OPERATION FOR INGROWN TOE-NAIL.

BY S. D. VAN METER, M.D.,

OF DENVER, COLO.

ONE feels considerable delicacy in claiming anything new in surgery, because it has been well said that "there is nothing new under the sun"; but, so far as I have been able to determine by a careful review of surgical literature, the following operation has not been published, although it is more than probable other surgeons have resorted to the principles involved. That it has not been recognized by the authors of the three most recent publications on surgery, is further justification of my claim to its novelty. Of the numerous operations advocated for ingrowing toe-nail, the operations of Anger, Cotting and von Bergmann are recommended as the best. It is admitted that the majority of cases can be cured by proper dressing, and the appliances, such as are suggested by Taylor and Webb, are of signal assistance in curing this condition without a cutting operation. The unwillingness of the patient, however, to submit to treatment often renders it advisable to perform a radical operation, although we know that with a little patience we shall succeed in effecting a cure without surgical interference.

The operation I have devised, and which I find most satisfactory, may be described as follows: After the usual cleansing preparation, and a thorough application of Harrington's solution, a diamond-shaped incision is made, under local anæsthesia, in the lateral aspect of the toe—as shown in Fig. 1. The upper lateral angle of this incision should come to within not less than one-quarter of an inch of the border of the nail, being careful to leave sufficient room in the healthy tissue for the insertion of a suture. The incision is carried down to the periosteum, and a diamond-shaped piece of tissue excised. Three fine sutures, preferably of fine silkworm gut, are used

936
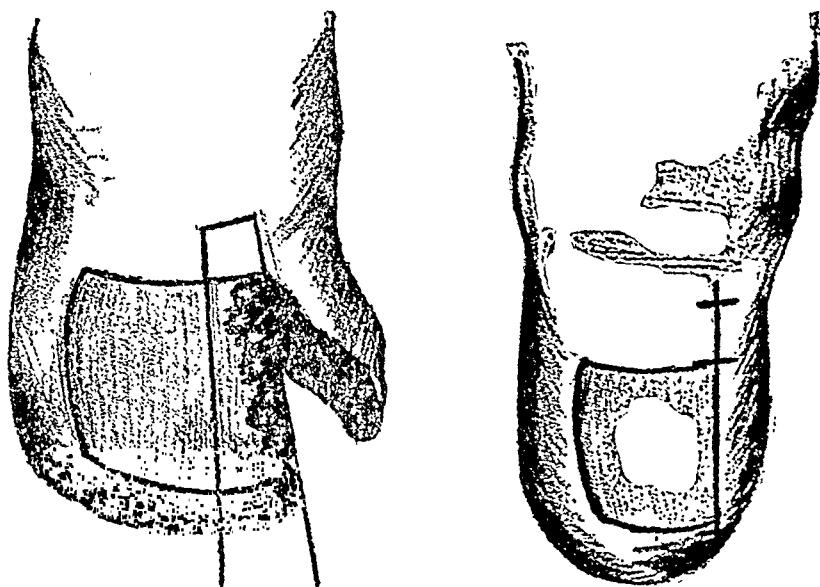
Anger's operation.

Cotting's operation.
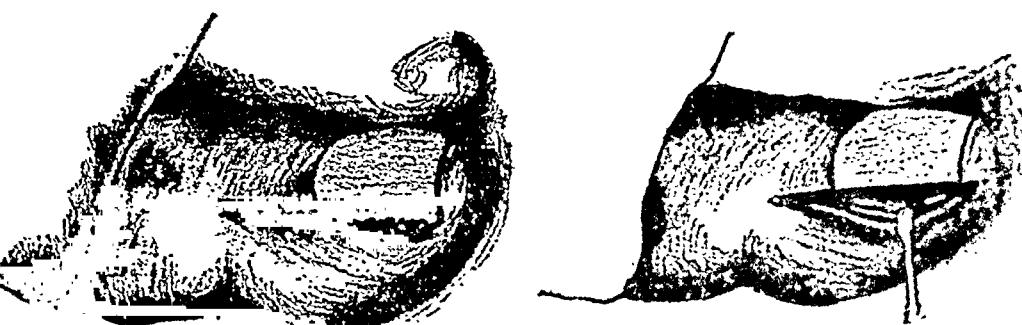
Vo Bergmann's operation.

to close the wound, the middle one being placed so as to coapt the lateral angles of the diamond.   This draws the overlapping exuberant granulation tissue away from the nail, as shown in Fig. 3.   At times, however, to expedite the retraction of this tissue, it is advisable to make a slight nick near the root of nail as shown in Fig. 3.   What we should expect, and what is

FIG. 1.

FIG. 2.
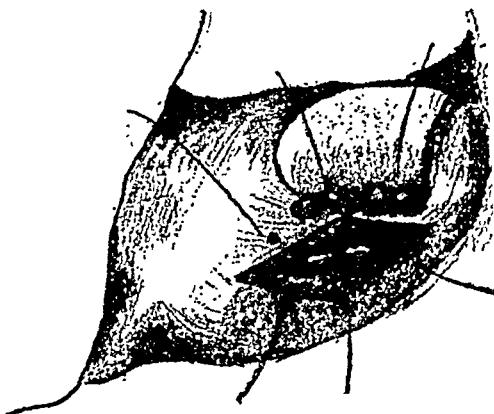
FIG. 3.
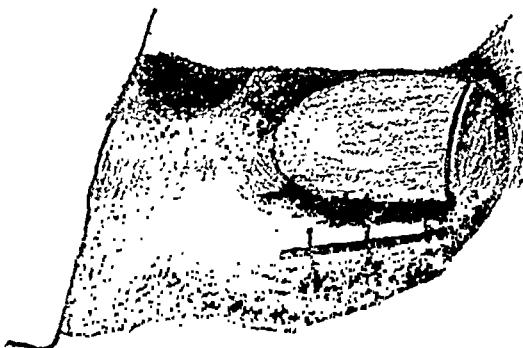
Van Meter's operation.

really accomplished by this operation, is the healing of the wound by first intention, having been made entirely in healthy tissue, causing a flattening of the lateral aspect of the toe, and not only effects a cure, but prevents a recurrence of the trouble.   No portion of the nail is removed; it is not mutilating; the convalescence is short, and the end result most satisfactory.

THE TREATMENT OF GONORRHŒAL ARTHRITIS WITH VACCINES MADE FROM THE GONOCOCCUS.*

A REVIEW OF FIFTY-ONE CASES.

BY H. F. HARTWELL, M.D.,

OF BOSTON, MASS.

(From the Pathological Laboratory of the Massachusetts General Hospital.)

STIMULATED by the visit of Sir A. E. Wright to this country in the fall of 1906, a number of cases of gonorrhœal arthritis at the Massachusetts General Hospital during the last two years have been treated with vaccines made from the gonococcus. The total number treated is larger than those here reported, but these have been selected because the diagnosis, according to the accepted clinical standards, seemed sure, and because they have all been seen a sufficiently long time afterwards to form an opinion of the permanency of the results.

It happens that all of these cases were males. In all there was a recent or an old urethral infection. In many there had been numerous attacks, which had left lesions in urethra, prostate, or testicles. Some had suffered other attacks of arthritis which had left crippling joints in their train. They all received local treatment for their urethritis. In some of the obstinate cases this was continued till subsequent cultures of washings from the deep urethra after massage of prostate and vesicles showed the absence of gonococci. We have not been able to note any effect on the urethral discharge by the use of these vaccines, though, of course, this was obscured by the thorough local treatment which was pursued at the same time. In some few cases, however, in which urethral treatment was withheld for one reason or another, while vaccines were being given for joint affections, no improvement in the urethral discharge was observed.

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* Read in abstract before the American Urological Association, June 7, 1909.

The vaccines were made from 24-hour cultures, grown on hydrocele agar slants. From these an emulsion of the gonococcus was prepared by washing off the surface growth with normal salt. This emulsion was killed at 60° C. for an hour, or by allowing it to stand in the ice-box over night, and then exposing it to lysol (1:400) for 12 hours. The number of gonococci in the emulsion was determined by counting, and vaccines were prepared in strengths varying from 100,000,000 to 600,000,000 organisms per c.c. No striking difference was noted between the results with the heated vaccines and those in which no heat was used. When possible, all cases were treated with vaccines made from the patient's own urethra or joint, an autogenous, or else with another strain which had shown good results, a stock vaccine.

Treatment in these cases was begun with a small inoculation, the amount being gradually increased to overcome the tolerance established. The acute were inoculated oftener and in smaller amounts than the chronic. In the former, an initial inoculation was from 10,000,000 to 25,000,000, and as progression was made, rarely exceeded 100,000,000. The vaccines were given at intervals of 2 to 4 days. In the chronic the interval varied from 5 days to a week, and the amount often was pushed up to 500,000,000 or 600,000,000. Occasionally toxic symptoms, such as headache, with nausea and vomiting, followed, but they quickly subsided, and produced no serious results.

In most of the cases an attempt was made to grow the gonococcus from the urethra, and in a few from the joints. The results of the bacteriological examinations follow:

	Positive	Negative	Total
Gonococci grown from urethra.....	21	30	51

Gonococci grown from joints:

	Knee	Ankle	Elbow	Wrist	Total
Positive	1	0	1	0	2
Negative	2	1	1	1	5
Total					7

From the urethra cultures usually showed a mixed growth of gonococcus and staphylococcus. From the joints both posi-

tive cases showed a pure culture, while the negative cases gave no growth.

Cole has shown in an analysis of a series from the Johns Hopkins Hospital similar in size to this, that gonorrhœal arthritis is polyarticular, and our cases well illustrate this fact. In 44, or 86 per cent., the infection was multiple at the time of observation, or a multiple involvement was shown in the history. Many which were monarticular at the time of examination gave a history of early mild infection in other joints.

From our observations in the employment of vaccines in these cases, it does not seem that much immunity was obtained by the first few inoculations. In several which were seen early, joints apparently previously uninvolved became acutely inflamed when already 3 to 5 inoculations had been given. It may, of course, be possible that this was caused by too large an inoculation, yet none of these patients exhibited toxic symptoms from their vaccines. It seems more reasonable, however, to look upon it as the clinical course of the gonorrhœal infection, where not enough immunity has been established by the inoculations to overcome a fresh invasion of the microorganisms.

The following case is cited as an example:

A young man was seen June 22. His first attack of gonorrhœa came on twelve days before, and his right wrist had been painful for five days. Examination showed the wrist swollen, the swelling extending along the radial flexor tendons. Motions of the wrist were painful and limited by spasm. The fingers moved freely. There was a purulent urethral discharge. The wrist was fixed with a splint, and 25 mil. stock vaccine given.

June 24: There was less swelling and tenderness, and the wrist motions were comparatively free without spasm. 50 mil. stock vaccine.

June 29: No pain in wrist, swelling the same. His right shoulder became lame the day before. Given 50 mil. autogenous vaccine grown from the urethral discharge.

July 1: The right shoulder was normal. 60 mil. autogenous.

He did not come for treatment again till July 9. He said he began to have severe pain in his left shoulder six days before,

which continued till yesterday. An examination showed tenderness about the joint, especially over the bicipital groove, and there was marked muscle spasm. The right wrist and fingers could be moved freely. No toxic symptoms had been shown after any of the inoculations. The left shoulder was confined with a sling, and he was given 60 mil. autogenous. He did not report again.

It is certain that no lasting immunity is conferred by the vaccines. Six of our patients had a recurrence of their joint infections at varying intervals after they had been discharged. In 5, the reinfection resulted from a fresh gonorrhœa, while in one, no evidence of a fresh attack could be obtained. The interval from discharge to reinfection in these cases was as follows:

	Cases.
3 months after cure	1
4 months after cure	2
5 months after cure	1
1 year after cure	1
1 year and 5 months after cure	1
Total	6

The question of the comparative value of autogenous and stock vaccines is of practical importance. The production of an autogenous vaccine requires the facilities of a laboratory, and even then, in many cases, it is as futile to grow the gonococcus from the urethra as from many of the infected joints. Torrey, Wasserman, and others working with the gonococcus, have found variation in different strains, both in cultural characteristics and in toxicity for animals. The specificity of immune substances would lead us to expect better results following the use of autogenous vaccines and our clinical experience in this series of cases seems to support this view.

Some of our earlier cases which were begun with stock vaccines, afterwards had autogenous, and we were impressed with the greater efficiency of the latter. Since these earlier cases, autogenous vaccines have always been used whenever the gonococcus could be obtained in culture. One can, however, be easily misled in interpreting the results in these cases. Gonorrhœal arthritis shows a variable clinical course, and it

not infrequently happens that an acute joint suddenly becomes quiescent, the phenomenon taking place with a rapidity comparable to the crisis of pneumonia. The rapid amelioration in symptoms which has followed the inoculation of autogenous vaccine, must be accepted, therefore, with some reserve.

The following case is one in which stock vaccine was first used, followed by autogenous:

Man, 25 years, admitted to the Massachusetts General Hospital March 6. He had gonorrhœa two years before, when the left ankle swelled, and he was disabled for one month. He first noticed the fresh urethral discharge one week ago, and the following day had a cutting pain in the right hip. Examination showed tenderness without swelling or redness at the right sacro-iliac joint, the motions of the right thigh caused pain referred to this region and to the hip. There was slight swelling, redness and tenderness across the left instep, but motions of the ankle were free.

March 8: Given 25 mil. stock vaccine.

March 14: Still had pain in right hip. 50 mil. stock.

March 19: Pain started in left hip three days ago, and he has been steadily growing worse. He lay with the left thigh flexed. The least motion of the left hip caused intense pain and was guarded by muscle spasm. There was marked tenderness with some swelling over the left groin. The right hip was comfortable, and he was able to move it fairly well. 25 mil. stock.

March 24: The left hip was still held flexed. It was less painful while at rest, but any attempt at motion caused pain, and was attended by muscle spasm. 25 mil. autogenous.

When seen the next day, he lay in bed with the left thigh completely extended. There was no pain, and the hip-joint allowed full motion without spasm. His further course was uneventful. April 1 he was walking about the ward with only slight stiffness, and he was discharged on April 9, with full motion in all his affected joints. He had received three more inoculations.

The following case received only autogenous vaccine:

H., 25 years. Was seen as an out-patient, May 13. His first attack of gonorrhœa was two months ago, and three weeks after this he said he had pains in both knees and the fingers of the left hand. These joints subsided in about a week, and at the end

of this time, five weeks ago, the left hip became painful. On examination the hip showed passive motion in flexion to a right angle, with 25° permanent flexion. It was held firmly at a right angle, and allowed no rotation nor abduction. There was one-half inch atrophy of the left thigh and one-quarter inch atrophy of the left calf.

The gonococcus was grown from the urethra. Between May 9 and May 23 he received four inoculations of a vaccine made from this strain, and improved continuously. May 26 there was absolute freedom of motion in the hip, and he walked without limp. November 23 word was received from him that his joint continued in perfect condition.

If we compare the results obtained in the cases treated with autogenous, and those in which stock vaccines were used, we find more evidence in favor of the autogenous. Joints which, after treatment, were capable of complete and full motion without any thickening or adhesions, or without enough thickening to impede their full functionating power, have been classed as " good." Those in which motion was impaired either by adhesions or thickening, have been called " poor." The results in this series were as follows:

	Good	Poor	Total
Cases treated with autogenous	19	2	21
Cases treated with stock	23	7	30

A further study of these 51 cases showed that 20 of them were seen within a few days of the onset of their joint symptoms. The remaining 31 had all been through an acute attack before they came under observation, and had been left with disabled joints.

Of the cases seen at the beginning of their attack, 11 were simple hydrops, and all were polyarticular except one. The vaccines diminished their pain and hastened their resolution. Some received massage as soon as the acuteness of the joints allowed. Leaving out those joints which had been disabled from previous attacks, there were only three of these patients who did not recover with perfect results. One of them, when first seen, had an acute infection of the hip, knee, and both thumbs. They all cleared up except the right thumb, which

suppurated, and became ankylosed. The second had been through two previous joint infections, which had disabled both knees and one hip. The third attack involved all the larger joints of the extremities except the shoulders and elbows. He was left with a permanently flexed and disabled right hip, with the other joints the same as before. This patient was so piteously crippled and helpless that he could not be moved to the Zander machines for passive motion. The third had an infection of the shoulder, wrist, and fingers, and had two stiff knuckles when discharged.

The following are examples of these acute polyarticular cases:

A negro, 22 years old, was admitted to the wards February 29. He had been suffering for two weeks with pains in his joints, and was confined to bed. Both wrists, both knees, and both ankles were swollen, tender, and painful on motion. There was fluid in the left knee, and a purulent urethral discharge. He received salicylates till March 5 without improvement. March 6 to March 23 he was given seven inoculations of autogenous vaccine, when he was discharged to his home. There was a rapid improvement and disappearance of pain. Twelve days after the first inoculation he was able to walk about the ward. At the time of discharge all the joints were normal except for a little fluid in the left knee, and slight limitation of motion in the left wrist. He came to the Out-Patient, and received four further inoculations, and by April 18 these two joints had cleared up. He reported nine months afterwards with his joints in normal condition.

Man, 23 years, first seen on May 13. Two and one-half years before there had been a multiple gonorrhœal arthritis, and a few months later another attack. He was laid up from work for ten days, and had stiff wrists and a stiff index finger as a result. His present arthritis had come on five days before. Both ankles, both knees, both wrists, both elbows, and the left sternoclavicular joints were swollen, painful, and tender. There was pain in both shoulders and in the sacro-iliac joints. The fingers and toes were swollen. There was fluid in both knee-joints. The urethra showed a purulent discharge. He was helpless and bedridden. Inoculations of an autogenous vaccine were begun on May 19. There was a steady improvement in the acute symptoms and a

gradual subsidence of the swelling. June 8 he was able to go about on crutches, but the joints were weak and the ligaments relaxed. He received daily massage, and June 24 could walk without any support. He left the hospital on July 3, and spent the summer in the country, gradually becoming more active. He continued to receive inoculations at intervals of a week to ten days. September 28 he resumed work. All his joints except the wrists and index finger, which had been stiff from his previous attacks, were normal. He had gained 12 pounds. He reported five months later, and was in the same excellent condition.

In nine of the acute cases, the process in the joints had become purulent or seropurulent, with infiltration of the periarticular structures. They were all monarticular. This is the type which seeks surgical care. Six of these cases recovered with joints which were capable of complete and free motion. In two of them, which were both suppurations in the knee-joint, some slight thickening remained as late as 5 months after their discharge, but this offered no obstacle to joint function. With the exception of aspiration, which was done for therapeutic as well as diagnostic purposes, these cases had no operative treatment. As emphasized by Cole, we place great importance on early motion in these joints. Fixation is continued only while pain lasts. Just as soon as the acute symptoms have subsided, they have been placed under the care of Dr. C. H. Bucholz for massage and passive motion, and we assign a large share in the final outcome to this treatment. The vaccines have been kept up while the sluggish induration was being absorbed, although it does not seem that they were very efficient in this stage, and thereby the period of their administration has been much prolonged.

Three of these 9 cases had more or less joint disability after their discharge. One was a suppuration of the elbow, in which there was one-third of the normal arc of motion, with periosteal thickening. Both the other two were wrist-joint infections, one of which became completely stiff, and the other had only about one-half of its normal motion. Vaccines seemed to have no effect on the pain and swelling in these two cases. Œdema in these wrist-joints was so marked that we

have thought it must be a determining factor in these poor results. With tissues so swollen, especially in a joint with so many small synovial partitions, there must be considerable resistance offered to the blood stream, and antibodies could not be brought in sufficient abundance to the inflammatory foci. Guided by this theoretical explanation, we have employed active hyperæmia produced by hot air to stimulate the congestion and carry off the œdema from the tissues. With two later cases of wrist-joint infection which were given daily hot air baking, the œdema was reduced, the pain was relieved, and they both had perfect results.

The following cases are examples of suppurating joints:

A. P., 35 years, admitted May 29. Ten weeks before he first noticed a urethral discharge, and eight weeks later, following a chill, the right knee became sore. It was very painful and the swelling had increased. Examination showed the right knee swollen and the capsule tensely distended with fluid. The joint was held flexed at an angle of 45 degrees and no motion was possible. There was a slight rise in temperature, ranging from 100° to 102° and very slight urethral discharge. About 50 c.c. of purulent fluid was removed from the joint at two successive aspirations, which showed gonococci in the smears and in culture. Inoculations of his own vaccine were begun June 3, and on June 16 the acute symptoms had quieted down to permit of light massage. He was discharged from the ward on July 2 with 45 degrees of motion, and came to the out-patient for vaccines and Zander treatment. July 31 he could completely extend his knee and went back to his work. He reported November 14, when the knee allowed free and full motion without fluid. There was a slight amount of periarticular thickening, the circumference over the patella being 2½ cm. more than over the left.

H. B., 28 years, admitted July 11. He had three attacks of gonorrhœa, the last six weeks ago. He first had pain in his left elbow thirteen days ago. Swelling soon appeared, and had rapidly increased. There was no urethral discharge, and examination showed the left elbow flexed at about 40 degrees. It was red, swollen, and tender. The capsule on either side of the olecranon was bulging, and but a few degrees of motion were possible. Swelling extended down the forearm to the dorsum

of the hand. About 5 c.c. of purulent fluid was obtained from the joint by aspiration, which showed a pure culture of gonococcus. July 15 an autogenous vaccine was begun. There was improvement, and he was discharged from the wards July 19. Vaccines were continued in the out-patient department, and he was given passive motion on the Zander machines. Treatment was suspended August 31, when there was complete extension of the elbow, nearly complete flexion, with slight limitation in pronation and supination. He reported November 11, and had increased the joint motion so that there was full flexion and extension. There was very slight limitation in pronation, which was accompanied by crepitus. Muscle atrophy was still marked.

Thirty-one, or more than half of our cases, were seen when the acute inflammation had subsided. They came for treatment at periods ranging from one month to a year after their acute attacks. They all had the typical indolent crippling lesions which are the sequelæ of this distressing affection. The joints were swollen, either from periarticular infiltration, intra-articular fluid, or œdema, and had shown little progress. They were stiff, and painful when used. The majority were so disabled that they could not work, especially those in whom the joints of the lower extremity were affected. In 27 of these cases the result of treatment was successful, and they were discharged with complete functionating joints without disability. They have all reported at intervals of a month to a year after their discharge, and in all the perfect joint function has been maintained. In many, the contrast in their physical condition at the time of last reporting and when they first began treatment was striking. The resumption of function in the joints had allowed them to exercise, they had put on weight, and had a rugged healthy appearance. In some in whom disability was slight, the length of treatment was shorter than in the acute cases. In others, with more marked and long-standing changes, it was much more protracted. Infection of the ankles and small joints of the feet was very obstinate. Many of these cases had everted ankles, and the constant strain of walking kept up the irritation. In some of them a successful result was only attained by manipulative correction

with rest in bed. The tender areas at the plantar surface of the os calcis, painful heals or talalgia, which were often seen in these cases, was another obstinate lesion. In all it eventually disappeared without recourse to operation. In no one of these cases, however, was a bone spur demonstrated by X-ray.

In 4 of these patients with chronic joints, the result of treatment was not satisfactory. Two were chronic infections of the ankle-joints, one dating back 12 years, another 6 years. They were treated during an exacerbation without effect on the pain or the deformity. Two with multiple joints, improved considerably, but they were both discharged with stiff shoulders.

Among these chronic cases there were 5 with stiff backs. In all except one there was, or had been, involvement of other joints as well. In 4 cases the stiffness had existed for a year or more, while in one, it was of three months' duration. In all of them motions were limited throughout the whole spine, and in any attempt at forward bending it moved as though fused. There was no deformity. There was pain in the lower dorsal and lumbar region, but it was not referred to the anterior aspect of the body. It often interfered with sleep. In one, the X-ray showed thickening about the lower dorsal and upper lumbar vertebræ. Improvement in all these cases was very striking. While they did not recover the complete freedom of motion of a normal back the spinal motions in all were very much increased and were free enough to give them no inconvenience in their work. They were entirely relieved of their pain.

From observation of these cases it would seem that gonococcus vaccines are a valuable therapeutic agent in gonorrhœal arthritis, in all stages of the inflammation except where ankylosis has occurred. They do not, however, seem to be able to prevent extension to fresh joints in early cases, and certainly do not produce enough lasting immunity to prevent recurrence of arthritis. Autogenous vaccines seem to be more efficient than stock, thus corresponding to the known specificity of biological substances.

BOOK REVIEWS.

OPERATIVE MIDWIFERY. By J. M. MUNRO KERR, C.B., C.M., Glas., Fellow of the Faculty of Physicians and Surgeons, Glasgow; Obstetric Physician, Glasgow Maternity Hospital. With 294 illustrations in the text. 8vo, pp. 705. New York, William Wood & Co., 1908.

Since the modern operations of Cæsarean section, vaginal hysterectomy, pubiotomy, symphysiotomy, and abdominal section for extra-uterine pregnancy, tumors, and similar intra-abdominal complications of pregnancy have been evolved and are so often performed in suitable cases by all well-prepared obstetricians, obstetrics has become essentially a part of surgery and the accoucheur to be successful requires a thorough surgical training.

Many years have elapsed since a treatise devoted entirely to operative midwifery has appeared in the English language. The recent volume by Kerr supplies such a want. The work is devoted entirely to the consideration of the indications of the various operative procedures now practiced in obstetrics, and a detailed description is given of the technic of operation involved in each.

Fully one-half of the volume is devoted to the subject of dystocia, and in the subdivisions of this general subject separate chapters are devoted to the consideration of the various conditions giving rise to difficult labor. The causes inherent in the forces of labor, in the birth canal or in the child itself, are systematically considered, and the different abnormalities of presentation, malformation of the child or pathologic changes in the maternal organs are clearly described and, so far as it is possible to do so, are illustrated by excellent plates, many of them made directly from material in the possession of the author.

The obstetric operations—version, forceps, symphysiotomy, accouchement forcé, vaginal Cæsarean section, and the different operations involving destruction of the child—are described in detail in separate chapters. Such pathologic conditions as moles, extra-uterine pregnancy, placenta previa, and the various varieties of hemorrhage form another group of interesting chapters, and,

finally, the various accidents occurring to either mother or child at the time of birth are carefully considered.

Few medical men are called upon to conduct a case of labor in which the product consists of a double monster, and even obstetricians of considerable experience will see in a life-time but two or three confinements so complicated; nevertheless, a practitioner may any day find himself face to face with such an obstetrical emergency, and it is therefore necessary for him to know what has been the usual history of such cases and in what way the difficulty in delivery can best be overcome. The chapter devoted to double monsters has been written by J. W. Ballantyne of Edinburgh, and is an excellent summary of our knowledge of this unusual condition.

One of the most important chapters in the book is devoted to the diagnosis of presentation by means of abdominal manipulations, and as this subject has been imperfectly considered in medical literature, the directions given are of unusual practical value.

As a literary contribution, the book is well worth reading, and the judicial manner in which the author marshals his facts and conclusions gives more than ordinary force to his teaching. He is eminently conservative. " A first labor is a trial labor; so with moderate pelvic deformity it is well to have recourse to any major operation only if nature fails after she has been given a long trial." This sentence may be taken as the text upon which the book is developed, and it would be well if all men called to attend women in labor would adopt the same conservative attitude. Few books that have appeared in medicine can be read with more pleasure and profit. The illustrations are new and excellent, and altogether the volume forms one of the most important additions to the literature of obstetrics that has ever appeared.

HENRY P. DE FOREST.

MANUAL OF OPERATIVE SURGERY. By JOHN FAIRBAIRN BINNIE, A.M., C.M., Professor of Surgery in the Kansas State University, etc. Fourth edition. Volume I. Philadelphia, P. Blakiston, Son & Co., 1909.

This book of Dr. Binnie's is rapidly outgrowing the limits which it set for itself at the beginning. In this fourth edition it has become a two-volume work, and this first volume considerably exceeds in its number of pages the entire original work,

although an attempt is still made to keep down its size to the requirements of an overcoat-pocket edition. One edition has followed another rapidly and this has testified to the popularity which the book has enjoyed; a popularity due somewhat to its convenience of size and attractiveness of typography, but more particularly to the fact that in it the reader has been able to find the latest things in surgical operative work, while the well-established and classical surgical procedures with which the ordinary books of operative surgery are concerned are omitted. In addition to this, however, that which has commended it doubtless to the majority of readers has been the practical nature of its contents as transmuted, by the experience and common sense of a most practical surgeon, from the literature of the subject. How difficult it has been, in the fecundity of operative surgery at the present time, to keep a book which attempts in any fair degree to present its advances, is well exemplified by the constant growth of this book. There is no opportunity for criticism as to the manner in which the author has carried out his scheme; it is altogether a useful and commendable work.

SURGERY OF THE UPPER ABDOMEN. By JOHN B. DEAVER, M.D., Surgeon-in-Chief to the German Hospital, and A. P. C. ASHHURST, M.D., Surgeon to the Out-Patient Department, Episcopal Hospital. In two volumes. Volume I, pp. 468, 76 illustrations. P. Blakiston's Son & Co., Philadelphia, 1909.

The first instalment of this work on the Surgery of the Upper Abdomen is devoted to the surgical lesions of the stomach and duodenum. The liver and bile passages, the pancreas, and the spleen, are to be considered in the second volume, the date of publication of which is not announced.

The general subject has been taken up in a broad and comprehensive way, the first fifty-five pages being devoted to the anatomy and embryology of the parts concerned, and to the physiology of digestion. The latest views on these matters are well summarized. The anatomical cuts would have been more useful to the average reader if references by line or letter to the different structures or organs had been added. The applied physiology is largely a résumé of the work of Cannon, Blake, and Murphy (published in the *American Journal of Medical Sciences,* and the ANNALS OF SURGERY, in 1905, '06, and '07). It is well done, and is both clear and readable.

The chapter on General Diagnostic Considerations might with advantage have included wider application of the anatomical and physiological facts previously described, but no other fault can be found with it. Particularly to be commended is the opening page on which the authors object to that conception of the surgeon's function—in intractable cases of disease of the upper abdomen—which, as they say, " is colloquially referred to as ' taking off the lid.' " We believe, as they seem to believe, that the expression might be regarded as an index to the surgical tone of the man to whom it applies. Attention might here have appropriately been called to the frequency with which abdominal symptoms,—rigidity, distention, etc.—are associated with supradiaphragmatic lesions although the abdomen and its contents are not directly involved. This has been a fruitful source of error and deserves emphasis.

The chapter on Benign Diseases of the Stomach and Duodenum is excellent. The differing claims of the internists and the operators are set forth and the evidence weighed with reasonable fairness. In the chapter on Gastric Ulcer the authors summarize their views (apparently but not unmistakably referring to benign diseases generally) as follows:

" Surgical treatment allows 95 to 98 per cent. of these patients to recover. Medical treatment allows 75 to 80 per cent. to recover. Surgery permanently cures practically every patient who recovers. Medicine permanently cures only 30 to 40 per cent. of its patients. Medical treatment is long and uncertain. Surgical treatment is rapid and sure." This is possibly a little extravagant, but they add that they have no desire to be understood as urging surgical intervention in every case of gastric ulcer, and continue: " Medical treatment should always first be tried, and only when methodical and energetic medical treatment has failed to cure the patient, after it has been persisted in for a reasonable time, or when several temporary cures have resulted in ultimate relapses, only then, we repeat, is surgical treatment to be considered in patients with acute, actively ulcerating lesions. In ulcers such as these, it is mainly on account of the complication of hemorrhage that the surgeon's advice is sought. Perforation is universally acknowledged to call for surgical intervention at the earliest possible moment. But in regard to hemorrhage there is still dispute."

As to the choice of operation in gastric perforation, although the facts now before the profession cannot be said to justify the final formulation of rules, we believe, with them, that at present in any case where it is not specifically and positively contraindicated, gastrojejunostomy should be performed.

Pylorospasm is accurately described as "only a symptom of some other malady," and the somewhat analogous condition of infantile stenosis of the pylorus is likewise regarded as a muscular hypertrophy brought about by persistent spasm due to irritation from some cause, such as hyperacidity of the gastric juice, or a small erosion or fissure.

The need for distinguishing the vomiting caused by acute dilatation of the stomach, when post-operative, from that due to the anæsthetic and from the vomiting of peritonitis, is emphasized and the conditions differentiated. Secondary gastric dilatation is assigned in the great majority of cases to obstructive causes, and the safe prediction is made that the so-called "atonic" cases will grow rarer—just as vesical "atony" has almost vanished—as the surgeon is given more opportunities to find the underlying cause of the condition.

Syphilis of the Stomach is considered in three pages. The fact is not noted that in nearly every case of so-called gastric syphilis that has been reliably reported there have been associated lesions—often gummata—of the liver. Many of the stomach conditions found may well have been secondary to the hepatic disease. There are some recent exceptions to this general statement but, for other reasons, most of them are unconvincing as to the specific character of the gastric lesions described.

Carcinoma of the Stomach is very fully and satisfactorily dealt with. There can be no dissent from the assertion that "the presence of cancer should be suspected when chronic gastric catarrh exists without any discoverable cause (such as abuse of food, of alcohol, of drugs; circulatory disturbances of the heart or liver; or diseases, such as gall stones, gastric ulcer, etc., which would cause some definite lesions in the region of the stomach), especially if this chronic gastritis be in a patient over forty years of age, and if it be attended by loss of appetite for meats (Kocher)."

It is also true that if a tumor exists the diagnosis is less difficult,—so many diseased conditions not associated with swelling or new growth being then eliminated. But that the characteristic

pyramidal shape of a pyloric growth can *frequently* be recognized we take the liberty of doubting, in spite of the authority of Kocher. We agree with the further statement that " occult blood in the stomach contents and fæces is the most valuable of the laboratory findings. In non-malignant ulcerations of the stomach, rest in bed with milk diet will cause the disappearance of occult blood. In cancer no treatment has any effect."

The practitioner to-day has, perhaps, no more difficult decision to make than in doubtful cases of this character at a relatively early stage. That decision will necessarily, for some time to come, depend not merely on the lapse of time or—in the absence of tumor—upon the persistence of catarrh, in spite of diet and medical treatment, but also upon the temperament of the physician, his previous experience with surgery—and surgeons—and his willingness to share responsibility for an operation which may prove to be only diagnostic—and that negatively. To say that " it seems to us that every case diagnosticated *certainly* as carcinoma of the stomach before operation is a disgrace to the attending physician, provided he has had the patient under treatment for more than a few weeks " seems a little intemperate in expression, while the context shows the very vagueness—due to the imperfection of our knowledge—that is the cause of the delays of which the authors complain. They speak of "that space of time "—referring to " a few weeks "—as if it were a definite period, and contend that within it the conclusion should be reached that an " anatomical basis " for the symptoms exists and—a non sequitur —that this can be removed only by operative means.

These remarks are merely in palliation and not in support of delay. With the general contention of the authors we are entirely in sympathy, and as for some time to come errors in one direction or the other will be unavoidable, we believe that it will be better for the patients if they are in the direction of hastening rather than postponing surgical intervention.

In Stab-wounds of the Abdomen, when the absence of protrusion of the omentum or escape of abdominal contents renders the existence of penetration of the abdominal cavity uncertain, they wisely advise that the surgeon make a layer-by-layer dissection, arrested at first at the aponeurotic and then at the peritoneal plane of the abdominal wall and they add: " We are thus insistent upon this cautious approach, and upon determining beforehand

whether the peritoneal cavity has been penetrated by the weapon, because it often happens that on opening the abdomen widely in these cases inspection shows no evidence of intra-abdominal lesion. and very extensive search becomes necessary to exclude the possibility of visceral injury; and if none be found to exist, and it is shown that the vulnerating weapon itself had never opened the peritoneal cavity, the surgeon will have subjected his patient to a quite unnecessary and by no means trivial operation. If, however, the fact of abdominal penetration has been definitely determined in doubtful cases by the method just described, the surgeon will be quite justified in his extensive intra-abdominal manipulations, even though no lesion be found more serious than hemorrhage from an omental vein."

In Gunshot Wounds of the Stomach early operation in civil life, and non-interference in military practice, are advocated, statistics demonstrating the correctness of both positions.

The chapters on the Technique of Operations while necessarily excluding many procedures still employed, represent on the whole the best methods of to-day, and are as well adapted to enlighten the intending operator as any with which we are familiar.

The statistical matter throughout is most useful and informing. Every effort has obviously been made to bring it up to date, as is exemplified by the reference (page 287) to the figures of Mikulicz (1901), Hahn (1898), and others, as "rather ancient."

The illustrations as a rule are excellent. The legends err on the side of brevity. We do not like to see adhesions involving the sigmoid flexure described as "perigastric," even though the underlying cause is thereby indicated.

The book is well written. We were inclined to criticize a sentence which speaks of a summary "as illustrative of the interrelation which unites the digestive processes in an orderly series of successively dependent events," but found that Cannon was responsible for it and not the authors. We see no reason why an American should write "endeavour" or "candour," or why any one should write "develope" and "developement." Certainly no one should write: "its greater liability to fatal hemorrhage and to perforation make a sudden death probable" (page 205); and the grammar of "the chief artery met with in the upper abdominal wall is the internal mammary or some of its terminal

branches " (page 2) is scarcely better. We rather like the word
" puked " (page 154) though its use has come to savor of literary
affectation. Postempski is entitled to have his name spelled either
without a " p " (page 267), or with a " p " (page 263), and not
in both ways.

In the index—which is well-made—*im*perforation of the
œsophagus refers to page 179 and not to page 129, where perfora-
tion is mentioned.

But all these criticisms are trivial. The book is a notable con-
tribution to one of the most important departments of modern
surgery, and reflects credit upon both the industry and the intelli-
gence of its authors and—in its physical characteristics—upon its
publishers.

<div align="right">J. William White.</div>

CORRESPONDENCE.

TORSION OF SPERMATIC CORD.

Editor Annals of Surgery:

The present report of a single case is submitted on account
of its rarity, as an addition to the literature of the subject.

A man, aged thirty-two, noticed a swelling in the left inguinal
region October 10, 1908. As a boy he had developed a hernia of
which he was apparently cured by truss pressure. During the
past ten years, however, he had at times noticed a swelling in the
inguinal region. When he again noticed this swelling, at the
last date mentioned, he applied a truss after having apparently
reduced the swelling, and was able to attend to his usual occupa-
tion for the day, suffering no inconvenience; but about midnight,
after retiring, he began to suffer pain in the inguinal region and
again noticed the swelling. This pain persisted and became very
acute with increase of the swelling, and when I saw him, forty-
eight hours after, he was suffering intense agony. On examina-
tion there was found a tense, painful swelling extending from the
external inguinal ring to the bottom of the scrotum; he also had
severe abdominal pain. He was nauseated, and vomited during
the day, but his bowels had moved normally. His temperature

was 100°; pulse 104. The enlargement was irreducible and exquisitely tender; dull on percussion. An inguinal incision was made as in a Bassini operation for hernia. After the superficial fascia had been incised a mass almost black in color presented itself in the wound. The condition, upon examination, was found to be due to a torsion of the spermatic cord, with necrosis of the testis. The twist in the cord was from left to right, that is, from without inward, and was comparatively easily untwisted. The whole necrotic mass up to the external ring was removed. The usual steps of a Bassini operation, including the splitting of the external oblique muscle, completed the operation. No evidence of a previous hernia was detected. An uninterrupted recovery followed.

MOSES SALZER,
Cincinnati, Ohio.

To CONTRIBUTORS AND SUBSCRIBERS:

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PRECAUTIONARY MEASURES

As every physician has constantly under his care cases of either typhoid, malarial, or bilious fever, it is well to remember that precautionary measures are possible, and, if taken in time, much of the trouble with these cases is avoided. If it be true that the materies morbi of these diseases belong to the bacillus group, the remedies manifestly are an antiseptic and an antipyretic. As an intestinal antiseptic we have nothing better than salol. The consensus of opinion is in this direction. When we add the antipyretic and anodyne effect of antikamnia, we have a *happy blending of two valuable remedies,* and these cannot be given in a better or more convenient form than is offered in Antikamnia and Salol Tablets; each tablet containing 2½ grains antikamnia and 2½ grains salol. The average adult dose is two tablets. Always crush tablets before administering, as it assures more rapid assimilation. *As the necessity of intestinal antisepsis in* the treatment of this class of diseases is fully recognized, would not the scientific treatment of the conditions preceding them be the administration of the same remedies? Fortifying the system against attacks is the best preventive of them.

A SUCCESSFUL STUMP SPEAKER

John Kendrick Bangs, the author, who spends so much of his time at his home on the Maine coast that he has become a citizen of that State, took part in last year's political campaign, and had many interesting experiences on the stump. He admits that in one instance the joke was on him.

At this particular meeting he was the third speaker, following two local spellbinders to whom the crowd listened patiently in anticipation of the "big gun" of the occasion.

The evening was warm, and while the second speaker was holding forth a fat member of the band, occupying a seat directly in front of the stage, yielded to the somniferous influences and snored loudly.

"That's one on you," chuckled Mr. Bangs to his fellow orator, as the latter closed his peroration and retired to his seat at the rear of the stage. "Now watch me wake him up!"

Sure enough, scarcely was Mr. Bangs well under way before the fat man opened his eyes, stared wildly for an instant—and bolted for the door!

—*November Lippincott's.*

RAILROAD ECONOMY

The economy practised upon the Great Northern Railroad is well known among railroad men, one of the stanchest believers in the old saying that "Economy is the road to wealth" being the president, J. J. Hill. The story is told in the West that upon one occasion when President Hill was looking over a piece of track he found a new railroad spike. Taking it to the boss in charge of that stretch of road, he handed it to him and said:

"You must be more careful. Nothing must be wasted. Pick up all your spikes as you go along."

"Why, Mr. Hill," replied the "boss" promptly, "I've been payin' a man a salary for three years to hunt for that spike."

—*November Lippincott's.*

PARISIAN POLITENESS

"That the French are the politest people on earth," says a New Yorker, who spends a bit of his time in Paris, "I have always been convinced; and a recent incident in a Parisian dentist's office accorded me additional confirmation of that belief.

"I entered the dentist's anteroom just as a patient—an exceedingly woebegone expression on his countenance—was approached by an attendant.

"'Whom, m'sieu,' inquired the attendant, with the most sympathetic of inflections in his voice—'whom shall I have the misery of announcing to *M. le Docteur?*'"

—*November Lippincott's.*

STATESMANSHIP

"Well, they've elected Blingsby to Congress."

"What! Did that soulless, truckling, lowdown politician——"

"Yes, and he told me he would push your name for local postmaster."

"Oh—Blingsby? Why, I did n't understand the name. That fellow's all right, and I've always said so. He's got the makings of a statesman—Blingsby!"

—*November Lippincott's.*

THE OPTIMIST

"I'm sorry to hear your mule died," I said to Happy Sam.

"Oh, it's all right, boss," he returned resignedly. "I ain't got no kick comin'."

—*November Lippincott's.*

THE USE OF GLYCO-THYMOLINE IN OBSTETRICS,

BY

GEO. H. SHELTON, M.D., DETROIT, MICH.

I am so gratified and pleased with the action of Glyco-Thymoline in the various conditions in which it is indicated, and especially so in obstetrics, that I cannot endorse it too highly. I have used Glyco-Thymoline in obstetrical practice wherever sepsis is present or threatened, and can say candidly that I have yet to meet with disappointment. The result in every instance has been simply charming. Did not time forbid I could recount numerous cases in which the happy climax was attributable to the use of Glyco-Thymoline. But for the purpose of this paper the report of two cases in obstetrics will illustrate typically its wide field of usefulness in this branch of practice.

Case 1. Mrs. J., age 26, multipara; was delivered at full term of a still-born child. It had been dead about ten days and was foully decomposed. Condition of mother was very critical. Temperature, 102.5 degrees. Pulse, 120. All symptoms of septicemia present. Two tablespoonfuls of Glyco-Thymoline to one pint of hot water as a douche three times daily brought about a wonderful recovery in a remarkably short space of time.

Case 2. Mrs. S., age 19, primipara. Premature labor, followed by puerperal fever. In this case the septic condition was such as to be truly alarming, but Glyco-Thymoline, two tablespoonfuls to one pint of hot water, to be used as a douche three times daily, produced a rapid recovery.

In conclusion wish to state that I find such general use for Glyco-Thymoline in obstetrics that I would not consider that I was fully prepared for any and all emergencies which might arise while attending a case of labor unless I had a supply of the above-mentioned remedy on hand.

NOT ROOM ENOUGH

While riding on an electric car, during his first visit to the city, a farmer passed the yard of a monument company, where gravestones and monuments were displayed. Turning to his host, he remarked in an awe-stricken voice, "They dew bury 'em close in the city, don't they?"
—*November Lippincott's.*

NOT YET

A Missouri clergyman had in his pastoral flock a member who was reluctant about meeting the contribution basket. The pastor had thrown out many broad hints, but all to no avail.

One day the member fell ill and was taken to the Ensworth Hospital. When the clergyman arrived the man was delirious. While the pastor was sitting beside his bed a wild yell of "Fire! Fire!" came from across the street.

The sick man drew himself up on his elbows. "Where—where am I?" he asked excitedly.

"Calm yourself, brother," soothed the pastor, with just the faintest twinkle in his eye. "You are still at the Ensworth Hospital!"
—*November Lippincott's.*

A PERTINENT QUERY

Freddy suddenly stopped playing with his blocks and gazed thoughtfully across the room. After a moment's contemplation, he turned to his father.

"Papa," he began, "why haven't I ever seen any little boy policemen?"
—*November Lippincott's.*

THE CHRYSANTHEMUM

Last tribute of earth to the year's vesper
  glow;
A kiss of the summer flung out to the snow.
God's herald of winter; yet coming to bring
  To the hearts of the faithful a promise of
  spring.
—CLIFFORD HOWARD in *November Lippincott's.*

LIPPINCOTT'S NEW AN

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P. S. Forms for the December number close
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remainder there was no osseous deposition. He was seen monthly for some time but no further growth of bone followed.

Fifteen months subsequently he returned to the hospital, his parents desiring that the arm should be removed, as they said it was "worse than useless," inasmuch as he required the other arm and hand to look after the flail-like one which was constantly dangling loosely by his side. The condition of the arm was then as follows:

The bone showed no definite increase since he had left the hospital. When the limb was allowed to hang by his side, the measurement of the proximal portion of the humerus, taken from the acromion process to the distal extremity of the proximal portion, was nearly two inches. In form, the proximal fragment was conical, tapering from the rounded head to a narrow, spike-like extremity. From this to the condyles there was a complete absence of bone, there being nothing but soft tissues in the gap. The muscular power was good, but when he attempted to raise his arm a contraction of the muscles took place, the condyles being drawn toward the proximal extremity, while some fibres of the deltoid raised the spike-like process of the upper portion, causing it to project as if about to penetrate the skin. Here the action ceased, the soft parts in the gap appearing like a rope during the muscular contraction. He could not raise his forearm to his breast. If one caught his arm firmly with the hand placed over the gap, so as to keep the condyles fixed and separate from the upper fragments, then the patient could elevate his forearm toward the chin. The power was there, the lever and fulcrum were wanting. It was determined to supply these by transplantation from other human bones.

In the wards there were numerous cases of marked anterior tibial curves, from which—in order to rectify their deformity—wedges of bone had to be taken, and these were utilized as transplants. An incision was made into the upper third of the humerus, exposing the head of the bone. Its extremity for fully quarter of an inch was found to be cartilaginous. In order to refresh the bone, the cartilaginous, spike-like process was removed, leaving then a portion of bone which measured one inch and three-quarters from the tip of the acromion process. From this point a sulcus about two inches in length was made in the soft parts, in a downward direction between the muscles. The former

presence of bone was nowhere indicated; there was no vestige of periosteum, and the sole guide as to the correct position into which the transplant was to be placed was an anatomical one.

Two wedges of bone were then removed from the tibia of a patient æt. 6 years, affected with anterior curves. The base of these osseous wedges consisted of the anterior portion of the tibia, along with its periosteum, the wedges gradually tapering toward the posterior portion of the tibiæ. After removal, they were cut into minute fragments with the chisel, quite irrespective of the periosteum. The bulk of the fragments had no periosteum adhering to them, they having been taken from the interior of the bone.

They were then deposited into the muscular sulcus in the boy's arm and the tissues drawn over them and carefully adjusted. The wound healed without pus production. Two months after, a portion of new bone an inch in length and three-quarters of an inch in thickness was firmly attached to the upper fragment of the humerus. In running the finger from the head of the bone toward the graft, the latter could be easily distinguished by the sudden increase in the breadth of the shaft at the point of junction of the old and new portions of bone. Now, instead of the former sharp spike-like extremity, the upper fragment ended in an obtuse terminal. Here all the grafts proliferated, grew to one another and also to the extremity of the proximal portion.

Two other wedges of bone of larger size than the first were similarly dealt with and inserted two months subsequently to the first graft, and a third couple were placed in position five months after the first. These filled the gap in the arm to the extent of four and a quarter inches, the humerus then measured six inches in length. Soon the utility of the arm was greatly restored.

This boy, from having been in the wards for a considerable period, began to assume " airs " toward some of the boys of his own age in the ward, and one of those seized an opportunity of " setting things right," whereby the first was thrown and had his restored arm fractured between the junction of the second and third transplants. This necessitated the exposure of the bone, the two fractured extremities of which were refreshed, sutured and fixed. The two extremities united just as a fractured normal bone would. Since this time he has been kept somewhat under observation, the patient making occasional visits to report.

Seven years after dismissal from the hospital, the humeral

shaft was found to have increased in length by one and three-quarter inches, being now seven and three-quarters, and it had increased in circumference to a marked extent and had assumed a somewhat irregular shape. The length of the sound arm had however considerably outstripped the length of the transplanted humerus. The patient could use his grafted arm for a great many purposes—taking his food, adjusting his clothes and in many games.

It is now thirty years since the humeral shaft was rebuilt, and during the greater part of this period the man has depended upon his physical exertions for the earning of his livelihood. He worked as a joiner for many years, and now is an engineer's pattern maker. His grafted arm has increased in length, but not proportionate to the increase of the sound one. Measurements: The grafted humerus measures, from the tip of the acromion to tip of internal condyle, 10 inches, but following the curve in the bone, it is 11 inches long. The sound humerus from same points measures 14 inches—3 inches longer than the other.

Photos: X-ray.—A skiagraph (kindly taken by Dr. Macintyre, Glasgow) shows that the increase in length of the affected arm has taken place almost entirely from the proximal epiphysis, as the new bone has been interposed between the proximal epiphysis and that portion of bone which grew from the transplantation. All but a minute portion of the distal epiphyseal cartilage was destroyed at the time of the osteomyelitis and, consequently, little growth in length would be expected from this extremity.

The increase in length of the diaphysis, which has occurred from the proximal epiphyseal cartilage, may be taken as an index of the amount of growth which usually occurs from the proximal humeral epiphysis.

Data Bearing on the Increase in Length and Breadth of Bone.—These facts corroborate and supplement some of the deductions made by John Hunter from experiments performed by him on the lower animals. He bored two holes in the tibia of a pig, one near the upper end and the other near the lower; the space between the holes was exactly 2 inches. A small leaden shot was inserted into each hole. When the bone had increased in length by the growth of the animal the pig was killed and the space betwen the shot was still the same, ex-

actly 2 inches. He inferred that " bones are not elongated by new matter being interposed in the interstices of the old."

Probably what is meant is that new additions of bone will be made to the length of the diaphysis from either epiphysis. To that extent the case detailed here agrees and shows that the diaphyseal increase in length occurs in the same way in man.

In this human case, however, the distal epiphyseal cartilage had been rendered in great measure functionless by disease, and the grafted portion, which was at first contiguous with the distal epiphysis, has remained nearer that end, while the increase in length has occurred mainly from the proximal epiphysis, and consequently the new bone has, for the most part, formed between this epiphysis and the grafts. At the same time it is interesting to observe that though the distal epiphyseal cartilage was for the most part destroyed, the epiphysis has increased greatly in bulk, though it is probably not quite of normal size. The grafted portion of tissue, which is easily recognized from ·the rest of the shaft by form and contour, has increased markedly in thickness and also somewhat in length, so that there has been here interstitial osseous increase.

It is presumed by some that the increase in length of the diaphysis comes mainly from the epiphyseal line toward which the nutrient vessel runs. In the present case the length of the humerus from the tip of the acromion to the internal condyle is 10 inches, and from the same points on the sound limb the measurement is 14 inches. If the measurement be taken following the humeral curve on the ,grafted humerus, then the length is fully 11 inches, and perhaps this is the fairer measurement if the increase in bone has to be considered.

After the 4½ inches of bone had been added to the limb by grafting, 28 years ago, the length of the humerus then measured fully 6 inches. If the measurement following the curve of the bone as it is now, be taken, then the length at present is 5 inches more than formerly, namely 11 inches. The greater portion of this increase in length has come from the proximal diaphysis, but still not the whole, as there has

been an interstitial growth between the fragments of the transplant, as their original form has been altered, and the irregularities constituting the various parts have been separated from one another by interposition of new osseous tissue. Though there are no positive measurements to go on relatively to the increase of interstitial growth in length of the part which had been grafted, still 1 inch would be a rough estimate of that increase,—the part that had been grafted would now measure about 5¼ inches in length instead of 4¼ as formerly. This leaves 4 inches of new growth to have come mainly from the proximal diaphysis. It also leaves 3 inches of shortening between the length of the sound and that of the grafted arm. Could this 3 inches have been made up were the distal epiphysis in normal condition? If so, the increase in length from the proximal epiphysis (if it were normal in this case) would only have been 1 inch less than that of the distal.

On many occasions subsequent to this bone-grafted humerus, grafting, transplanting and reimplanting of bone have been successfully practiced by me, in the human subject, both in the bones of the diaphyseal extremities and in the flat bones of the skull, in order to make good defects arising from many different causes. It would occupy too much space to give details of all these cases—three out of the number must suffice.

Mosaic Work of Bone. Skull.—Can a flat bone, such as those of the cranial vault, continue to grow and its elements proliferate after it has been deprived of its periosteum and has been reimplanted? There have been many opportunities of testing this, from which the following observation may be cited:

CASE.—A weak, ill-fed boy, æt. 9 years, was admitted into Ward 29, Glasgow Royal Infirmary, in January, 1884, suffering from a compound comminuted fracture of the skull, with penetration of the brain substance, received about two hours previously by the fall of debris from a chimney. The brain symptoms are not referred to here.

There was a wound situated over the left side of the head of a somewhat crescentic shape, and extending from above the

middle of the left eyebrow to an inch behind the auriculobregmatic line. The depressed portion was somewhat elliptical, with very irregular margins. It measured at its broadest part 2½ inches. All of these portions of bone were depressed below the level of the skull. most of them having penetrated the brain membranes into the brain tissue. These portions of bone were all elevated. It was found that they consisted of 11 pieces, the periosteum having been scraped by the injury from all of these, with the exception of the most posterior one, which was only partially denuded. Many of them were infiltrated with lime debris, brick-dust, etc.

These pieces as they were elevated, were placed in an aseptic solution. They were then pared with a chisel in order to remove the debris. This was especially necessary over the external surface, where they had been scraped and ingrained with dirt. They were afterwards thoroughly washed in an aseptic solution, divided into fragments and replaced. In this way a mosaic work of 14 pieces of bone was formed. It was difficult to retain these in position, owing to four things. First, to the extent of the osseous defect; second, to the fact that the dura mater had been so extensively lacerated and torn that it formed a very irregular floor to rest the fragments upon; third, to the great bruising and crushing of the scalp, which rendered it difficult to bring the several pieces into apposition, and made sloughing of a part of it almost certain; and fourthly, to the force of the cerebral impulses, which caused a distinct movement of the fragments, producing crepitation by the one rubbing against the other. It was feared that owing to these four circumstances some of the fragments would be shed.

It is to be borne in mind that the periosteum had been by the injury entirely removed from all these fragments, except the most posterior one, and that most of them had to have their external surface pared with a chisel. The soft tissues were brought together as well as possible and the wound was dressed.

On the sixth day after the operation, the wound was examined. A portion of the anterior aspect of the flap, which was lacerated and contused, had sloughed, and already the process of separation from the living part had commenced. On the tenth day the wound was re-examined and this portion of the slough was removed. It was then seen that four fragments of bone were exposed, two of which lay side by side and presented a striking contrast. The one was suffused with the pinkish blush of life,

the other with the pallor of death. The condition of the remaining exposed fragments was doubtful, one of them however being very pale. On the twenty-first day, at the next dressing, two pieces of bone were found to have shed, while all the remainder had lived. The wound was all but healed. At the termination of a month it was firm.

Had that large osseous defect, about 2½ inches in greatest breadth, extending from the middle of the left eyebrow to the auriculobregmatic line been left without this mosaic work of re-implanted bone, the cranial periosteum, if any of it was left at that part, would have failed to have covered the defect with bone, and a permanent fibrous covering transmitting the cerebral impulse would have marked the seat of injury. Yet, here we re-implant the osseous fragments, and the majority of them live, grow and throw out ossific matter sufficient to unite them individually to one another and to the rest of the uninjured cranium.

Ten years after this operation, the lad was examined. He was then 19 years old, strong and robust. The skull was firm all over, the bone over the site of prior injury had grown in proportion with the rest of the skull.

CASE.—*Restoration of Transverse Ramus of One-half of the Jaw by Transplantation of Bone.* A girl, 15 years of age, had the horizontal ramus of the lower jaw on one side extirpated from a diseased condition in childhood. The remaining ramus was by subsequent contraction displaced, so that it lay with its mental extremity nearly in contact with the ascending ramus of the opposite side. The remaining portions of the jaw were atrophied from disease. The teeth of the upper jaw projected over space. Mastication was in abeyance. Saliva constantly trickled from the defect. An otherwise beautiful face was hideously deformed.

Many surgeons and dentists had been applied to in turn, in the hope that they might rectify the deformity. The former would say that they could do nothing, but would advise the dentist to be consulted, as a plate might be introduced. The dentist would look at the gap and say it was impossible for them to put in a plate until the surgeon would give the patient a something to rest the plate upon.

It was resolved to try the effect of transplantation of bone, although the difficulty of securing asepsis so near the oral cavity was evident.

The first step consisted in freeing, by an incision through the skin, the extremities of the ascending ramus of the jaw on the left side and the horizontal mandible on the right. This was difficult without opening the mucous membrane, as it was so closely adherent to the extremities of the atrophied bones. After this had been accomplished, a portion of a human rib, of size sufficient to fill the gap between the left ascending ramus and the middle line of the jaw, was removed subperiosteally, divided longitudinally into strips and inserted into the gap in the soft tissues and secured to the bones on either side so as to keep the right mandible in its proper position. The soft tissues were then closed over it and the wound was dressed and healed.

One small portion of the transplanted bone became loose, and projecting against the scar, was shed. The remainder lived, slowly augmented in volume until firm union between the ascending right ramus and the left mandible was secured. She could then open and shut the lower jaw and use it freely. The lips came together, the overflow of saliva from the mouth ceased. The contour and symmetry of the face was restored. Some months afterwards the dentist was able to introduce a plate which rested on the newly-formed jaw, not only aiding mastication, but enhancing the appearance.

It is now six years since the restoration of the lower jaw and the transplanted portion has grown thicker and an increase commensurate with the development of the face has ensued. The increase in length has occurred principally from the lower extremity of the ascending ramus. She is now perfectly well, can use the mouth freely, for mastication, she speaks well and the now symmetrical and beautiful face bears no mark of scar, as the slight one which remains is hidden under the jaw.

A second somewhat similar case, though of less extent and presenting fewer difficulties was likewise operated on with a good result.

Professor Cameron, of Toronto, Canada, has reported to me that he had seen and examined a man in which I had 20 years previously transplanted about five inches of the tibia, and that the limb was now a thoroughly sound, reliable member which enabled the patient to engage in hard laboring work. The transplanted portion was however much thicker than the other parts of the tibia.

NOTES ON DERANGEMENTS OF THE KNEE.

BY ROBERT JONES, F.R.C.S.,

OF LIVERPOOL, ENG.

A CLASSIFICATION of the mechanical conditions which give rise to derangements of the knee is difficult in the present stage of our knowledge. It is the more needful therefore to add our experiences and impressions to those already chronicled. Without including operations for disabilities arising from causes extra-articular, I have opened the knee joint over five hundred times, and in spite of this perhaps unique experience, I am quite prepared in cases even with classical symptoms to find my diagnosis wrong. A young woman dancing, a cricketer hitting to leg, an old lady removing the bed clothes with her foot, a direct blow on the knee, a trip, a twist, a jar, a miner working with fully flexed knee—in each case something gives way. The events following the sudden symptoms may be widely different. In one case the joint may have locked; in another acute pain is present; in another, obstinate effusion may occur; in another pain, effusion, and locking are absent, and despite these differences the diagnosis in each case may be the same. It is not my intention in this paper to statistically summarize my experiences, but rather to deal with the subject as it has affected me from the clinical side. On looking over my notes, I find a long list of affections upon which the disabilities depend, the most frequent of which are: *Injuries to the semilunars, synovial fringes, joint lipomata, loose bodies, exostoses, injuries to ligaments, bony separations, dislocation of the patellæ.* The most common of these is injuries to the semilunars.

Before proceeding to the discussion of these specific conditions, it will be well to restate certain anatomical points in reference to the mechanism of the knee and the attachment of the cartilages.

ANATOMY OF THE KNEE JOINT.

The knee is a modified hinge joint in which the articular surfaces of the bones are not closely adapted to one another, and in which there is never more than a small area of the femur in contact with the tibia in any position of the joint. This allows a slight degree of sliding movement and of rotation to take place in addition to the hinge movement.

The great strength of the joint is dependent on the integrity of the crucial ligaments and of the extrinsic ligaments and muscles. It is therefore necessary to give some account of the ligaments and of the semilunar cartilages so far as they have a direct bearing on internal derangements of the knee, especially displacements of the cartilages.

The external lateral ligament consists of two portions, a short inconstant posterior portion and a long anterior portion which, along with the tendon of the biceps, strengthens the joint on the outer side. It is a rounded cord extending from the external tuberosity of the femur to the head of the fibula, where it is attached between the two portions of the tendon of the biceps. It is entirely distinct from the capsule of the knee joint and is separated from the external semilunar cartilage by the tendon of the popliteus and the intervening bursa (Fig. 1).

The internal lateral ligament is a structure of great importance, for it plays a part in the production of the common displacements and injuries of the internal semilunar cartilage. Its superficial aspect is shown in Fig. 2, in which it appears as a long somewhat fan-shaped band. Its deep aspect, however, is intimately blended with the capsule of the joint and is firmly attached to the internal semilunar cartilage (Figs. 1 and 3). It is to be noticed that its deep fibres are really shorter[1] than those of the ext. lat. ligament, and consequently the internal semilunar is very closely moored to the internal condyle of the femur, a fact to which we shall refer again.

The semilunar cartilages are crescentic discs, thick at the convex border and thin at the concave margin, hence they are wedge-shaped in transverse section. Each cartilage assists the opposite lateral ligament in resisting lateral movements of the leg, for it acts as a wedge between the tibia and femur and helps to make the crucial ligaments tense.

The semilunar bodies consist of a core of fibrous tissue, arranged transversely and longitudinally, with a covering above and below of hyaline cartilage. The longitudinal fibres are continuous at the cornua with the fibres attaching them to the tibia, a few of these fibres sometimes are continuous in front from one cartilage to the other, forming the inconstant and unimportant transverse ligament.

At the convex border, fibres of the capsule blend with the transverse fibres of the matrix of the semilunar. The fibres coming from below are rather stronger and form the so-called "coronary ligaments," which are really only the portions of the capsule between the semilunars and the tibia.
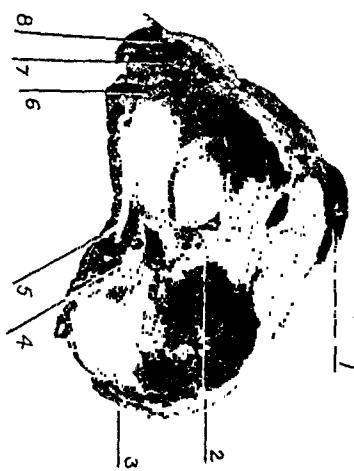
FIG. 1.

FIG. 2.

FIG. 3.
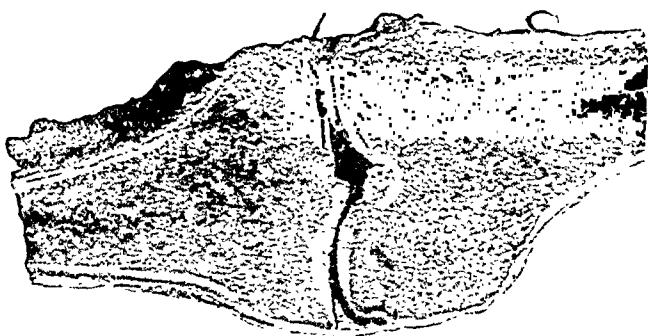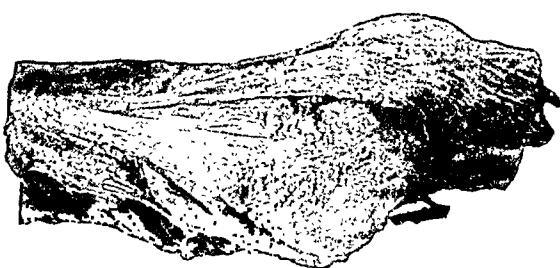
ANATOMY OF THE KNEE JOINT.

FIG. 1.—1, ligamentum patellæ; 2, anterior crucial ligament; 3, internal lateral ligament; 4, posterior crucial ligament; 5, fasciculus from posterior end of external semilunar; 6, tendon of popliteus; 7, external lateral ligament. 8, bifurcation of tendon of biceps.
FIG. 2.—Internal lateral ligament. The insertion of the vastus internus in exceptionally long.
FIG. 3.—Saggital section through internal lateral ligament, showing attachment to semilunar cartilage.

The external semilunar is separated from the capsule at the point where it is crossed by the tendons of the popliteus, while at its posterior horn a special slip of attachment runs up to be attached to the popliteal notch of the femur along with the posterior crucial ligament (Fig. 1).

On the other hand, as is shown by the accompanying figures, the internal semilunar cartilage is attached to the capsule along the whole of its convex margin, and is firmly attached to the strong internal lateral ligament as shown in the accompanying sections. The anterior cornu is always attenuated and its attachment to the tibia is never very strong and often very slender. It is easy to see that a sudden strain on the internal lateral ligament, especially if the femur is being rotated inward on the tibia, will tend either to detach the anterior cornu or split the cartilage longitudinally, or in rare cases cause a transverse rupture opposite the attachment to the internal lateral ligament.

FIG. 4.
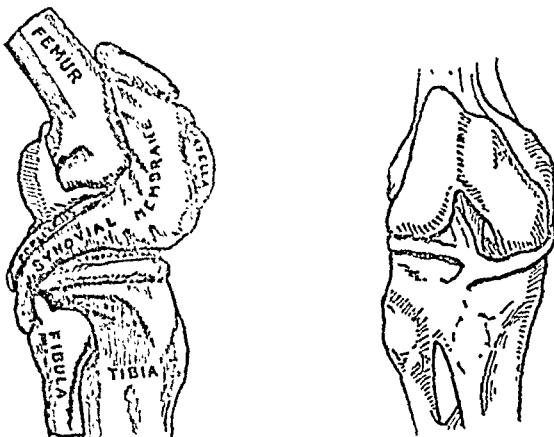
Structure of the knee joint.

It may be stated briefly that flexion of the knee takes place between the semilunars and the femur, the discs moving with the tibia; and that rotation occurs between the tibia and the discs, the latter moving with the femur.

The ligamentum mucosum is not a true ligament, but is the free upper border of the fold of synovial membrane which passes backwards to the anterior crucial ligament just below the patella. When the knee joint is opened above the patella, and the latter is turned forwards, two folds of synovial membrane are seen passing back on each side of the ligamentum mucosum. These are described in the text-books of anatomy as ligamenta alaria.

Tenney[1] has drawn our attention to the fact that the alar ligaments described by Morris and others cannot be found in joints hardened in formalin and from which the condyles of the femur have been removed subsequently; he states, however, that their apparent continuation as two fibrous folds of the extensor aponeurosis on each side of the patella can

always be seen. Pauzat traced these fibres down to the anterior ends of the semilunar discs, so that their effect would be to pull the discs upwards and forwards when the quadriceps contract. Tenney could not confirm this observation but traced the fibres into the infrapatellar pad of fat, and he considers that they pull up the synovial membrane and infrapatellar pad of fat and prevent the synovial membrane covering this pad from being nipped between the bones—an accident referred to by Hoffa[2] and others, which frequently occurs when the quadriceps extensor is atrophic and weak.

The motions of the joint are anteroposterior gliding movements and rotation of tibia upon femur. The ligaments allow of no other movement. In no position of the knee is lateral movement allowed, but when flexion is partial considerable rotatory movement can take place, and every time the knee is fully extended a certain degree of outward rotation normally occurs. The ligaments which prevent side-to-side movement during extension and during slight flexion are the laterals, and during the more acute flexions the crucials. It is obvious, however, that in conditions of strain the muscles are valued accessories—the rectus in front and the hamstrings behind—but they are quite inefficient as substitutes for either the crucials or the lateral ligaments should they be put out of action.

Griffiths,[3] of Cambridge, who has written a thoughtful article on the mechanism of the knee, having severed the internal lateral ligament, found that during extension of the limb the tibia could be appreciably bent outwards and the articular surfaces of tibia and femur correspondingly separated. If the same joint were flexed the crucials prevented such movement. In a case of complete rupture of the internal lateral ligament in a wrestler, I confirmed this experiment clinically and in another patient, where a portion of bone accompanied the separation of the ligament, no lateral movement was permitted during acute flexion. A strain upon the ligament is much more severe when it is twisted as well as stretched. Now, how can such a twist be applied? It takes place when the knee is flexed, the foot abducted, and the femur rotated inward. It is, in fact, in this position that strain and rupture of the internal lateral ligament and displacement of the semilunar cartilage almost always occurs.

A study of the anatomy shows us that there is a very close association between injuries to the lateral ligaments and displacements of the semilunars. An important point to remember is that from the closer approximation of its ends the external cartilage is more movable than the internal, and this is made more pronounced by the laxity of the part of the capsule to which it is attached.

EXPERIMENTS ON THE CADAVER.—Experiments on the cadaver show that extension of the knee is limited: First, by the posterior crucial ligament; second, by the anterior crucial ligament; third, by the internal lateral ligament; fourth, by the external lateral ligament, and that an increased range of movement is obtained as each structure is divided in succession.

External rotation of the leg is limited by the two lateral ligaments and is increased if either be ruptured or cut.

Internal rotation of the leg is limited by the internal lateral and anterior crucial ligaments.

In external rotation the tibia may slip forward slightly on the femur but is stopped by the anterior crucial ligament.

In internal rotation the tibia may slip back a little but is stopped by the posterior crucial ligament.

In the cadaver when the joint is extended and weight put on it the external semilunar cartilage can be made to fit closely to the condyle, but in no other position. The internal semilunar cannot be snugly fitted to the internal condyle in any position (Tenney).

FUNCTION OF THE SEMILUNARS.—The function of the semilunar cartilages is to assist the opposite lateral ligaments to resist lateral movements of the knee. It acts as a wedge between the tibia and femur and makes the crucial ligaments more tense.

When the leg was forcibly abducted on the cadaver, Tenney found that the internal lateral ligament tore away from its femoral attachments. The femur then slipped over the posterior end of the cartilage and when replaced crumpled up the posterior half of the internal semilunar. He points out that this is different from Hoffa's operative experience in which he found the anterior half of the cartilage curled up.

Clinically, it is the lower attachment of the ligament which usually gives way; the semilunar is then drawn back by the condyle, its anterior end gets worn and pinched between the bones.

We have seen that bending inwards of the knee in the extended and semi-extended position is prevented by the internal lateral ligament. Bending inwards of the knee during the fully flexed position is prevented by the crucial ligaments. These two anatomical facts should be remembered in their relation to displacement of the internal semilunar. One can thus easily understand how it is that the internal lateral ligament so frequently suffers injury. It is subjected to strain whenever the foot is firmly planted and abducted and the knee either slightly bent or kept extended (Fig. 5). If, in addition to this, as in the stroke to leg in cricket, or the final act of the bowler, body weight with rotation of the femur is added, we have produced that stretching and strain which Griffiths has proved to be so harmful to the integrity of the ligament. Indeed, the strength of the knee joint can be well gauged by the resisting power of the internal lateral ligament. Circumferentially, the internal cartilage is attached to the tibia by structures which allow the cartilage to be lifted fully a quarter of an inch—a point which is of importance. If the internal lateral ligament be torn above the level of the joint the cartilage remains upon the tibia; if torn below the level of the joint it follows the rotary movement of the femur. If the ligament be ruptured above and below the level

FIG. 5.
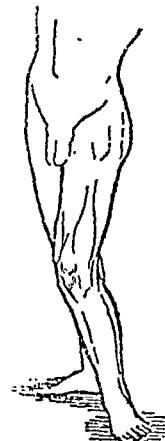
of the cartilage, it becomes a very simple matter to push it within the joint, a not unusual position to find it in. It would appear, therefore (Griffiths), that displacement or fracture of the cartilage can only take place when the internal lateral ligament is stretched or ruptured. This allows a separation of the joint surfaces and a slipping inwards of the cartilage; as the separate bones snap back the cartilage is nipped, and the knee is fixed in a very painful manner. The pain and effusion can be ascribed to injury to the synovial membrane, with which, as I have already stated, the cartilages are covered.

INJURY TO CARTILAGES.

In practically all cases the cartilage is displaced inwards, and in those rare cases where a protrusion has been felt from the outside it is due either to bruising and hemorrhage or to a buckling of the cartilage which gives an irregular feel to the articular margin. When we consider the wedge-shape of the discs, a displacement outwards could not possibly produce a locking of the joint; this can only occur when the displaced cartilage, acting as a foreign body, gets jammed between the bones. It is this internal displacement which gives rise to the acuteness and painfulness of the attack. We must all have been struck with the absence of anything abnormal from an external examination of a knee subject to recurrent attacks.

Now, what are the symptoms of displacement of the semi-lunars? The most constant symptom is a sudden inability fully to extend the joint; the cause of the displacement is strain thrown on the internal lateral ligament while the knee is flexed and the femur rotated inwards (Fig. 5). The force necessary in a first injury is generally great, the pain acute, and the victim, if an athlete, hobbles laboriously off the field with flexed knee. He is afforded a certain degree of relief by his friends in the pavilion, who fully flex his limb and then extend. When he reaches home the practitioner finds a distended knee, painful to manipulate. The strain which is most painful is that caused by stretching the structures on the inner side of the knee, and this is most acutely felt over the site of injury. In a certain proportion of cases, even with the knee fully extended, a gap between the bones on the inner side can be obtained by manipulation. For several succeeding days

there will be pain on pressure over the articular edge of the tibia opposite the ligament, and, generally speaking, some pain between the bones on pressure to the inner side of the patella. In a fortnight or three weeks, and after rest and massage, the patient is by common consent allowed liberty to walk. As we shall see later, this liberty is a mistake and the outcome of very indifferent surgery. Days, weeks, or months may elapse when again a train of symptoms, similar in character, but generally milder in effect, occurs. Many successive attacks, some grave and followed by effusion, some so trivial as merely to incommode, mark retrogression. In nearly all cases there is a history of strain or injury, the initial displacement as a rule being the most severe, while in the constantly recurring case any eversion of the foot may give rise to the displacement. I have had occasion to operate but twenty-four times for an external semilunar, which in my personal work only represents a 7 per cent. proportion. The reason the internal cartilage is so frequently involved is dependent entirely on anatomical grounds. Being, as we have seen, more firmly fixed by ligamentous attachments than the external, there is not the give and take about it which is found in the less controlled external cartilage, especially in the rotatory movements of the joint. Again, in the normal relation of femur to tibia the line of force is carried through the inner side of the knee; this is further emphasized by the abducted position of the foot which, if exaggerated, produces outward rotation of the leg. Another reason may be found in the fact that owing to the shape of the internal articular surface of the tibia the internal condyle of the femur can glide backwards on the tibia; thus the range of internal rotation of the femur on the tibia, which is a direct strain on the semilunar, is greater than that of external rotation.

Out of 117 cases operated upon (1906, 1907, 1908) for injury to the cartilage in which a lesion of the disc was found—

53 were torn from their anterior attachment.
16 were split longitudinally.
8 were attached by the cornua and torn from the capsule.

7 were displacements of the posterior horns.

12 were fractured transversely opposite the internal lateral ligament.

8 were loosely bound circumferentially with no other appreciable abnormality.

8 had undergone changes in the loose anterior extremity of the semilunar of a nodular type, some being as lumpy and large as a pea.

3 cases exhibited no trace of the cartilage.

2 cases showed the anterior part doubled and adherent to the posterior part.

In the remaining cases it was difficult to classify the injuries; some cartilages were so friable as to tear when grasped with the forceps and others presented fringed edges.

Apart from slipping, the most constant symptom of injured semilunar, in over 400 cases operated upon where the lesion was present, was localized pain on pressing over the injured spot. This was felt for fully a month after injury. It is best elicited while the knee is flexed, when pressure between the bones can be more effectively made. Locking was found in less than half the cases. Effusion was present in nearly all cases after the primary injury, and lessened or disappeared in proportion to the ease and frequency with which further displacements occurred. In one case where operation was refused for a long time, and where the patient had for three or four years slipped his knee several times a week, barely any inconvenience was experienced beyond a sort of rocking in the joint. He had no effusion, and consented to be operated upon only because he was going abroad on a sporting expedition. The anterior part of the internal semilunar was fractured and displaced into the intercondyloid notch, while the external cartilage was detached in front. In other cases where the symptoms were often acute, barely any lesion except a looseness of the moorings could be found. In five cases where the symptoms—generally historical—pointed to injury of the external cartilage, the lesion was found on the inner side. In two cases operated upon since 1908, the internal cartilage was found on the outer side of the joint.

As mentioned, during the years 1906–1908, I found 117

demonstrable lesions of the semilunar cartilages. During those years, however, I opened 190 joints with symptoms of derangement. In 30 I found thickening and irregularity of the structures about the ligamenta alaria. I found 9 cases of pedunculated fringes of a polypoid appearance. In 10 cases, I could find no lesion after careful search; in 3 of these cases—to be referred to later—I found on subsequent operation that the symptoms were due to the behavior of a tendon over an osteoma, and in 1 to a small fracture irregularity on the femoral condyle. In 8 cases the starting signs of hypertrophic arthritis were present; in 9 cases there were isolated loose bodies, and in 4 cases, loose bodies attached by pedicle to the synovial reflection. The remainder presented villous arthritis along the articular margin, lipoma arborescens and fibrous thickenings around the attachment of the anterior crucial ligament. In 20 of these additional 73 cases I expected to find injured semilunars, but was mistaken.

Many of the cartilages which I have removed at various periods had undergone changes which rendered them barely recognizable,—some were nodular and fibrous, some thin and frayed and some adherent to that part of the tibia on which they lay. The loose bodies are very interesting. They may be cartilaginous, bony, fibrous or fatty. When fibrous, they usually result from unabsorbed blood clot. The lipomata may be small or large, and develop in the synovial tissue, being attached usually by a pedicle. The larger lipomata are usually found to the side of the ligamentum patellæ. Hypertrophy of the synovial villi is frequently confused with a damaged semilunar. The condition is much more common than is usually expected, and I have frequently met with it in exploring joints. It is usually primarily the result of synovitis,—frequently later, the cause of it. The whole joint may become papillomatous, or a few isolated fringes may be found generally where the synovial membrane meets the cartilage. They are often pedunculated, may be found anywhere along the articular margin, and are composed of fibrous tissue, fat and blood-vessels. In spite of the difficulty of an accurate diagnosis, effort should be made to differentiate.

DIFFERENTIAL DIAGNOSIS.—Injury of the internal semi-lunar is diagnosed by the acuteness of its onset, by the persistence of pain on pressure over the detached or injured area, by tenderness less pronounced over the inner side of the patella, and by a locking of the joint. The patient usually refers the pain to the front of the joint until pressure decides it for him. Irregularity is sometimes found along the articular margin and often a sense of discomfort when the tibia is abducted and rotated outwards, even when the toe lightly touches an obstacle. The history of the mode of production is helpful.

Injury to the external cartilage produces a similar train of symptoms occurring on the outer side of the knee.

Synovial Fringes.—The symptoms of the nipping of a synovial fringe are less acute in its primary occurrence than are those of a displaced cartilage. The pain is strictly local and is not participated in by the internal lateral ligament. Frequently a prominence may be found over the site of pain, and no matter how often the nipping occurs effusion follows, creaking in the joint is a frequent accompaniment, and often an obvious swelling occurs on each side of the ligamentum patellæ (due to the chronic thickening of the infrapatellar pad).

Loose Bodies.—Loose bodies can usually be found and isolated by the patient. They often lock the knee but only transitorily. The symptoms are sharp but not acute, and unless pedunculated they may be referred to different places. Effusions are common.

Lipomata will sometimes lock the joint. There is often swelling about the lower part of the patella and painless effusions. Exercise rather than accident produces the symptoms which are rarely acute, and pressure on the knee will produce no pain.

Osteomata can be found by manipulation and by radiography. They sometimes lock the joint when a muscle or tendon becomes entangled. Such cases I shall briefly relate.

Rupture of the crucials, of which I shall relate cases, is the accompaniment of so severe an injury that other structures

participate in the general strain. The tibia can be made to glide in a to-and-fro direction, and when the knee is flexed lateral movements are free. If the lateral ligaments are torn, lateral movements in the extended position are also free.

I am quite conscious that despite any amount of care in diagnosis, error is inevitable in a number of cases, and only exploration can give us accurate information. For some weird reason, on occasions all the symptoms may point to injury on the inner side and when an exploration is made no lesion can be found. One such case I shall relate.

CASE I.—A young man of firm muscular development received an injury in a football scrimmage. His knee locked and he was laid up in bed for three weeks. He complained of pain, as far he could recollect, both on the inside and on the outside of the patella. Five weeks later, when jumping over a ditch, his knee locked, but only very transitorily and he was able to reduce it. He complained of pain on the inner side of the joint over the lateral ligament. On three subsequent occasions something gave on the inner side of the knee, and when he consulted me, some weeks after his last attack, all tenderness had gone. I decided that the internal cartilage required removal, but when I explored it I quite failed to find any defect in its appearance or behavior. I examined for loose bodies or hypertrophied fringes, but quite without success. Thinking that perhaps a loose body might be found on the outer side, I explored that aspect of the articulation through a second incision. To my great astonishment, instead of a loose body I found that the posterior horn of the external cartilage was doubled over and displaced forwards. Complete removal of this cartilage resulted in recovery.

CASE II.—I shall relate another case to show how a displaced cartilage may not give rise to any typical symptoms. I saw a boy of 18 who periodically had effusions in his knee, accompanied by much creaking but no pain. Three years previously he fell, but gave no history of locking, and walked a mile home. Next day his knee was much swollen and for a fortnight he rested it. For three years this effusion continued, with short intervals. The knee felt stiff; it sometimes pained when fully extended, but never once did he feel anything give in the joint, nor was pain

ever referred to any localized spot. Every variety of treatment had been tried and discarded before I saw him—rest, splints, massage, exercises, electric baths—but all of no avail. I determined to evacuate the joint by lateral incisions, and if necessary inject the cavity with iodine and alcohol. On entering the articulation and peering around, I saw the anterior end of the internal cartilage thinned and detached and lying very flat to the inner side of the anterior crucial ligament. I removed the cartilage and evacuated the contents of the joint. Movement and massage were started in a fortnight, and the patient made a slow but uninterrupted recovery.

I mention these two cases as being of considerable clinical interest in order to emphasize difficulties of accurate diagnosis. It must not be thought, however, because of these very exceptional cases, that it is useless to attempt classification. On the contrary, the case where a diagnosis is difficult or impossible is the exceptional case.

The most common injury to the knee joint is a sprain or rupture of the internal lateral ligament. As we have seen, this should not be mistaken for a slipped cartilage. In the one case a derangement is experienced, in the other it is never so. Next to the injury of the internal lateral ligament—which is often commonly called a sprained knee—injury to the inner cartilage is most frequent, and the problem of treatment must be solved. I maintain that a great distinction should be made between a primary and a recurrent luxation. I never operate in any but recurrent cases, and I have no doubt that were the first offence intelligently dealt with and at once, the proportion of such recurrence would be materially diminished. This may not be quite orthodox, but I cannot help feeling that it is quite true. Surgeons point to the thinned and battered cartilage, fractured here, displaced there and ask, " What can mechanism do here? " It is quite true! . A time comes when operative measures are inevitable, but that is only when cartilages inefficiently reduced or far too frequently nipped, show the evidences of their maltreatment. The first displacement will not be accompanied by any degenerative change, and the

knee will very often quite recover if appropriately approached. (*a*) Reduction must be absolute. (*b*) All movement of the cartilage must be checked until union of the torn structures is complete. (*c*) No lateral strain must be allowed until the torn or stretched internal lateral ligament has recovered its tone and strength.

With regard to reduction it does not matter what method is employed provided easy full extension is secured. Too often,·more especially in badly displaced or protracted locking, the surgeon is content to acutely flex and extend the joint, and if at last, though full extension is not quite free, a back splint is applied and extension (which should be secured by manipulation) is brought about by pad and bandage, what probably happens is this: Reduction not being quite complete, there remains a slight obstruction to full extension, and the pad and bandage tightly compress the cartilage between the bones. Let us remember as we would an axiom, that we can only be assured of reduction when the knee can voluntarily be held in complete extension. It has been authoritatively stated that extension of the knee is often not possible because of bruising of the cartilage.[4] I would venture to insist on a reduction in every recent case of which easy extension is alone the proof. I learned this lesson some years ago. A youth, subject several times before to slipping in his knee, came to me straight to the pavilion from the cricket field. His joint was locked at an angle of 40 degrees. I put the limb through the orthodox manipulation, and it came nearly straight. I tried again with a similar result, and felt inclined to be content. "It is not in," he said, and, humiliated, I strove in public for five minutes, when, without any objective sign he cried, " Now I am right," and the knee could forthwith be held extended.

In reading text-books one would conclude that the reduction of a displaced semilunar is the easiest possible routine. This is a deduction based on very limited experience, for some cases are specially difficult to reduce. In the majority of instances, reduction is easily effected; in a few recent cases it is difficult; in some old cases it is extremely troublesome. What

is the best routine manipulation? Acute flexion, lateral deviation and rotation inwards and full extension. Acute flexion is always painful, but it is the only position where internal rotation of the tibia is most free; lateral deviation separates the bones which hold the cartilage, and full extension allows of readjustment and places the limb in such a position as to permit of accurate union of the internal lateral ligament.

RETENTION OF THE CARTILAGE IN A FIXED POSITION.— This can only be secured when the limb is fully extended. In all rotary and lateral movements of the joint the cartilages participate. It follows, therefore, that both these movements should be prevented if we are to strive for accurate union of the torn attachment to the cartilage. Rest of the limb in a fully extended position is therefore indicated, and rest should be accomplished in bed so long as effusion lasts. Do not let us forget that a joint distended with fluid relaxes by elongation of all the protective soft structures of the joint, and the more rapidly we attain absorption the more we avoid a prolonged weakness. When all fluid is absorbed and the knee resumes its normal aspect, we proceed to the next stage. It may be days, it may be weeks; if slow, massage may help, but under no conditions must flexion be allowed. Flexion, as we have seen from the anatomical conditions, interferes with the moorings of the cartilage and the integrity of the lateral ligaments, both disturbances quite inimical to union of the torn structures. The third indication is to prevent for a prolonged period lateral deviation of the joint. We have seen that in derangements of the cartilage strain or rupture of the internal lateral ligament is a necessary incident; it follows, therefore, that during recovery no lateral strain should be thrown upon the knee.

Sir William Bennett [4] and Mr. Whitelocke [5] in their interesting monographs differ from me in my conclusions regarding the prevention of lateral strain. Although the latter author agrees that early rest, " from theoretical considerations . . . would seem only reasonable and common sense," he adds. " that the cases treated by shorter methods and with

movements from the first are to say the least no more liable to recurrence." In my opinion, a short splint, devised merely to prevent flexion and lateral deviation for the first few weeks, offers the only logical hope of recovery to the injured structures. Afterwards massage and exercises can be assiduously employed.

One of the simplest methods of preventing strain upon the internal lateral ligament is to walk upon an inverted foot with inturned toes. Seeing, as I do, a great number of cases of rickets, I am in the habit (when treating a genu valgum in an early stage) of insisting that the patient should walk with parallel feet, so aided by altered boots that the body weight is deviated from the inside to the outside of the tarsus. This throws a slight strain upon the external lateral ligament, and enforces pressure upon the inner articular surfaces of tibia and femur. So effective is this pressure that it generally suffices in a few months to correct the deformity. You can understand, therefore, what an important ally we have in so simple a measure to relieve the injured internal lateral ligament from strain.

In cases where the cartilage becomes displaced at frequent intervals I order an alteration in the heel and sole of the boots. The heel is elongated and raised on its inner side, and the inner side of the sole is fortified by a small wedge of leather. When the patient stands in such a boot the foot is inverted, and the lateral strain which is needed to displace the cartilage is avoided. If, in addition to this, the young athlete be told to walk with an inturned toe, and to run pigeon-toed, strain is inevitably thrown upon the external lateral ligament, while the internal lateral ligament is protected. Although immunity from displacement cannot be assured by this device, it materially lessens the tendency to its occurrence and becomes a valuable asset amongst our remedies. In addition, a splint must be employed.

In those cases where operation is not advised, or is rejected, a splint is indicated, so devised as to prevent lateral strain upon the knee, and to allow free movement. In all

recurrent cases which do not need operation, and in all cases of first displacement sufficiently recovered for flexion to be allowed, one orders a splint, alters the boot for the purpose of inverting the foot, and disallows walking except with parallel feet and running except with inturned toes. In addition to this, the quadriceps, as the guardian muscle of the knee, must be energetically massaged and otherwise kept fit and strong. May I once again emphasize the importance of adequately treating the first displacement, and of insisting that if the treatment is conducted on the lines I mention quite a large proportion of cases will make excellent and permanent recovery. The recovery depends upon complete reduction and uninterrupted union and consolidation of both the internal lateral ligament and the ligamentous moorings of the cartilage. In operating, as we so often do, on old injured cartilages, we are apt to be unduly biased when we see their thinned and battered edges. This condition can only be the result of frequent injury, and should not discourage us in the mechanical management of a first slip. I have at the present time many athletes playing tennis, football and cricket who have undergone a rigid mechanical treatment for undoubted displacement.

The question will be naturally asked: " What are the indications for operation? " I shall try to define my attitude in regard to mechanical and operative treatment.

In the first place, I *refuse to operate* in any case I see early, the subject of a first derangement. I *discourage operation* in those recurrent cases where the symptoms are transient and not followed by irritation of the joint. I *strongly urge operation* in those cases where a recurrent displacement is at times followed by acute symptoms. I advise it in all recurrent cases where a strenuous athletic life is a means of livelihood or a physical necessity. I think operation absolutely imperative in the case of men who work or stand in dangerous places and where a yielding of the knee may lead to serious consequences. Practically age has no influence over me if the indications I mention are present. I have operated upon a boy of fifteen and a woman of fifty-four.

Is there any danger apart from periodic trouble in a slipping semilunar? I can clinically support Mr. Arbuthnot Lane [v] when he says it may prove the exciting cause of tubercle. Frequently I have examined patients with tubercular knees and patients with rheumatoid arthritis whose early history was associated with internal derangements of the knees and in several cases of badly recurring injuries I have found sometimes congestion and sometimes erosion of the bone and cartilage upon which they rested. One case to which I shall refer bears upon the point.

CASE III.—Some eight years ago, a youth, aged 19 years, consulted me concerning a cartilage which two years previously became detached. Several recurrences took place, some of them followed by synovitis and enforced rest in bed. I urged removal of the cartilage. The youth, however, persistently refused my overtures and only grudgingly and spasmodically wore the splint. In less than eighteen months I noticed that one of the attacks left him with a thickened and sensitive knee, which in time refused gradually to extend fully. At the present time he has recovered from a typical tubercular knee, firmly ankylosed.

This case is specially interesting to me as I have been able to watch the development from the beginning. Another case, a man aged twenty-five years, a boilermaker, sprained his knee. Later he became a frequent patient, with slipping internal semilunar. Three years after, creaking and swelling of the joint led to the suspicion of the hypertrophic variety of rheumatoid arthritis, which radiography fully confirmed. Of two cases, carefully watched, each refusing operation, one resulted in rheumatoid and the other in tubercular change. I would suggest, therefore, that this danger should be kept well in view, and that patients with either a tubercular or rheumatoid diathesis subject to recurring derangement should early be persuaded to have the exciting cause removed.

Is operative treatment invariably successful? In the great majority of cases a perfect recovery may be predicted; in a certain small percentage of cases the symptoms recur. The

recurrences were far more numerous some few years back, when the cartilages were sewn to the tibial attachments. The same causes which accounted for the initial displacements produced the recurrence. Since it is customary to exsect the cartilage other causes than a displacement must be searched for in answer to symptoms. It will then be discovered that the so-called recurrence is due to an overlooked accessory factor in the production of the symptoms of derangement. I shall illustrate this by very briefly referring to cases.

CASE IV.—A young woman of 24 complained of a locking which was referred to the outside of her joint. It had recurred on several occasions, was sometimes accompanied by pain and sometimes followed by effusion. On occasions the slipping was not accompanied by locking. On opening her knee joint the external semilunar was found torn anteriorly, and I removed the anterior half. A month did not elapse before slipping again occurred, and on careful enquiry as to locality no reliable history could be obtained. I therefore opened the knee from the inner aspect, as I felt I should have seen any abnormality had it been present on the other side at my first operation. Floating by a thin pedicle a small fibrous nodule presented, which was removed with scissors, and the knee soon recovered its normal function.

CASE V.—A miner of about 30 complained of a slipping in his · joint, sometimes accompanied by locking. There was always sensitiveness over the articular border, between the patella and the internal lateral ligament. There was often effusion. On opening the joint I found the anterior portion of the semilunar abnormally free, but apparently not detached. Having several times found a similar condition, for which I exsected the cartilage with restoration of normal functions, I exsected here, and for some months no symptoms were experienced. Later, however, quite similar symptoms were complained of, and pain, again referred to the inner side of the knee. I followed the line of the old scar and searched for a cause. I was almost closing the wound when internal rotation of the tibia dislodged a loose body which shot out of my wound.

Both these cases illustrate the danger that more than one

mechanical defect may exist in a joint, and the removal of merely a part of them will not cure the patient. We must therefore carefully inspect a joint when it is opened, to make sure that we have attacked all those elements likely to give trouble.

Loose Bodies.—As early as 1803, according to William Hey, successful removal of these bodies was performed, but one learns from the account of Larrey [7] how dangerous an operation it was. In 1861 he collected 169 operations from the time of Ambrose Paré for simple removal of these bodies, 131 by direct and 38 by indirect or subcutaneous incision. By the direct method 99 were cured—several with ankylosis, 5 failed and 30 died. By the operation in two stages 19 were cured, 15 failed and 5 died.

I have already referred to the similarity in symptoms between these cases and injured cartilages, and suggested points for differentiation.

One has met quite a large variety of loose bodies in joints, some derived from organic changes, sometimes in connection with the hypertrophic type of osteoarthritis, sometimes due to detachment of cartilaginous or bony structure, others introduced from without. For quite a long time a young woman puzzled all whom she consulted, for intermittent effusions, locking of the joint but hardly any local tenderness on pressure. She often walked a mile with barely appreciable discomfort. When we X-rayed her knee (Fig. 6) it was found to be full of needles, which I removed by a large flap incision. The patient, who was a wilful neurotic, delighted in surreptitiously introducing needles into her joints. She is now quite recovered and doing hard work.

The treatment of loose bodies of whatever kind is their removal. It is quite true that they sometimes become fixed in a harmless place, but it is hardly worth our while to wait for this. If the body can be localized and fixed this is a very simple matter, and the operation will be described later. If it cannot be localized it is probably pedunculated, and the surgeon generally finds it when the operation has been performed

in the expectation of finding slipping semilunar—indeed, the symptoms are identical. In such a case it will nearly always be evident, even by the small incision we make for a semilunar. Often large numbers of bodies pour out of the wound, some as small as millet seeds and others quite large and irregular.

DERANGEMENTS OF THE KNEE DUE TO EXOSTOSES.—I have many times operated upon joints that became locked or obstructed by the slipping of muscle or tendon over exostoses.

In one instance (Fig. 7) an athlete on several occasions was suddenly pulled up while running, with a pain at the upper part of his popliteal space with sometimes considerable swelling. An X-ray revealed a pedunculated exostosis which occasionally obstructed the vastus. It was surrounded by a bursa, inflamed and containing fibrous masses.

Fig. 8 is a type of one of four cases and will serve as a clinical picture of the rest. The patient, a youth, comes with the history of a knee which slips at the back. It nearly always occurs when active or unusual exercise is being performed. The knee sometimes completely locks, and in such a case is often difficult to reduce. Generally, however, it is as one would expect a sense of discomfort and slight slipping which prevents whole-hearted athleticism, and frequently the patient falls, gets up again, feels the back of his knee and off again he runs. Sometimes it is the biceps which is hampered, at other times the inner hamstrings, and in one instance I removed a pedunculated exostosis which constantly became entangled with the outer head of the gastrocnemius. Fig. 9 shows an osteoma which ceased to trouble when it fractured. The fracture never united and the osteoma is now considerably reduced in size. Fig. 10 shows a flattened osteoma which gave rise to symptoms suggestive of inner semilunar, really due to its contact with the sartorius and semitendinosus, and the osteoma shown in Fig. 11 also obstructed tendons. More rarely symptoms may arise from sharp exostoses over the adductor tubercle, as shown in Fig 12. Usually there

FIG. 6.
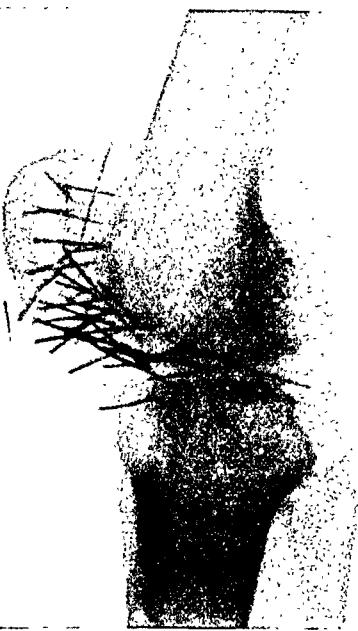
Knee joint filled with needles.

FIG. 7.

Exostosis of femur near the knee joint.

FIG. 8.

FIG. 9.

Osteoma which fractured and then ceased to give trouble.

Fig. 10
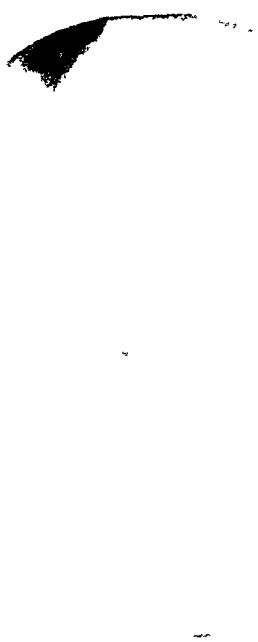
Exostosis of tibia near the knee joint.

Fig. 11.

Exostosis of tibia near the knee joint.

Fig. 12.

Exostosis from the adductor tubercle of the femur.

Fig. 13.
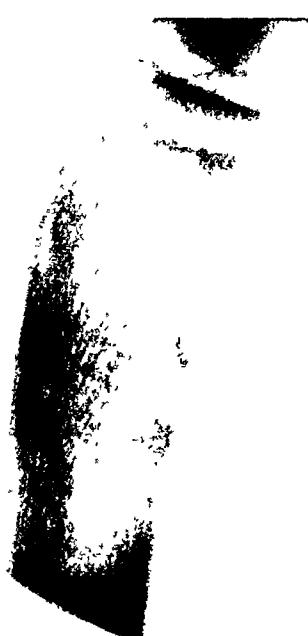
Exostosis of tibia involving the quadriceps tendon.

should be no difficulty in making a diagnosis in these cases, more especially if an X-ray photograph be available. The fact is, however, that osteomata are not associated with knee derangements because they so often exist giving rise to no symptoms. Fig. 23 shows a most interesting osteoma which constantly became involved in the fibres of the quadriceps. Removal of these masses should be performed even in the growing epiphysis if they give rise to symptoms, and care should be taken to make the removal complete.

THE SNAPPING OR CLICKING KNEE.—A condition very puzzling, but one which most have probably encountered, is a loud click on acute flexion and sometimes on complete extension. This condition has been described as "trigger knee," because of its characteristic snap. It is most frequently experienced when extension is all but complete. You place your hand upon the patient's knee and ask him to extend his joint; this he does almost perfectly until about 170 degrees, when the remaining distance is performed suddenly accompanied by a click and usually an outward rotation of the tibia. The cause is difficult to explain and is generally ascribed to a disturbance of the movement of the external semilunar, which is successively caught and freed between the joints. Two cases I operated upon may throw some light upon what the surgeon may sometimes expect to find.

CASE VI.—A bank clerk not given to athletic sports presented such a knee. He complained of a sense of insecurity, more, he said, imaginary than real, and he told me that his health was undermined because of the nervous irritation it caused. The click, though most uncomfortable, was not accompanied by pain and never by effusion. He refused the suggestion of mechanical treatment, and I explored his joint. I was desirous of not opening his joint by a large anterior flap, and without any real reason I entered it from the inner instead of from the outer side. At once the cause was apparent. Tapering from the anterior portion of the cartilage and attached by a cartilaginous pedicle was a chrondrous structure the size and shape of a flattened pea. It lay loose just on the inner side of the anterior crucial ligament,

not so far back as the spine. On extending the joint the click was heard, but I could not, of course, see exactly what occurred. I removed the anterior portion of the cartilage, the tadpole ending, and I was able at once fully to extend the knee without the occurrence of the sound. There was a distinct wearing of the cartilage over the short track traversed by this nodule. The patient made a complete recovery. My second case very closely resembled the first. Clicking on extension of the joint was constant but not complained of. Periodically, however, the joint locked, and it was for this reason I was consulted. The locking was on the inner side, and I therefore approached the joint from this aspect. The anterior portion of the cartilage was thin and cordlike, quite detached and ended in a thickened extremity On removal of the cartilage, the clicking disappeared, and the patient also recovered the proper function of his joint.·

I shall be very interested in future cases where this puzzling symptom is present. The mechanical treatment of such a condition consists in the application of a splint which, while allowing movement of the knee, prevents its full extension.

Some years ago I operated on two cases, where a clicking could be felt at the back of the knee. In both instances it was due to the slipping of the semimembranosus tendon over a small tibial exostosis. In both cases the disability was frequent but not constant, and at times weakness and soreness were present.

A third case was both interesting and instructive. A man, æt. 24 years, complained periodically of a locking knee. The locking was accompanied by scarcely any pain, and it seemed to take place in the popliteal space, never in front of the joint. Generally there was no great difficulty in releasing the leg; the patient by very rapidly flexing the limb at once freed it. On occasions, however, the locking was very complete, and the knee would remain flexed for some time until medical aid arrived. An exostosis could be felt just above the insertion of the biceps tendon, which when removed was found to be bicornate, like the letter Y, and the tendon sometimes slipped over the whole of it and at others was received between the horns. In each of these cases, removal of the exostosis remedied the defect.

FRINGES AND INFRAPATELLAR PADS OF FAT.

In 1906 to 1908 inclusive I operated upon 51 cases which would come under this division, in which I do not count early cases of rheumatoid arthritis. In 30 cases the condition was directly associated with the infrapatellar pads, and in none did I discover any connection with the suprapatellar pads. The condition has been described by several writers, including Hoffa [2] and Tenney.[3] The latter writer refers to two types— one occurs in the case of very fat folk where the thickening is due to the same causes as the general lipomatous condition. In this type the intra-articular masses shrink as the fat is absorbed in other parts of the body. In the second type the disability is associated with the young and athletic.

My experience of the condition is of long standing, and I will relate a case which will serve as an example.

CASE VII.—A young footballer lost his place in his team because of recurrent effusions after hard games. On the first two occasions the initial symptoms simulated dislocation of the semilunar without locking, but often no derangement could be noted and effusions were present without a knowledge of injury. At times he experienced a feeling of weakness in the quadriceps, which sometimes allowed him to fall when running down hill and restrained him from doing his best work. I saw him twice with the effusion and once during the recovered stage. At no time was pain complained of over the lateral ligaments nor tenderness over the articular margin, symptoms which are so characteristic of semilunar trouble. On pressing upon the patella while the knee was fully flexed and continuing the pressure during the act of extension a sense of discomfort hardly amounting to pain resulted. There was a marked thickening on each side of the patella. The recurrent effusions, the nodular firm swelling at the sides of the patella with the occasional yielding referred to the quadriceps suggested changes in the infrapatellar pads of fat. An operation revealed this condition and with a long curved scissors the pad was removed, when several small tabs compressed at their extremities revealed the mechanism of the lesion.

Fibrous hardening of the mass and the presence within it of

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traces of old hemorrhage were found on making a section of the fatty mass removed.

The patient was later able to resume first-class football without discomfort or sense of weakness.

This case is typical of most of the others excepting that in some cases where the tabs are elongated, more pronounced symptoms of derangement predominate over thóse of synovial irritation. In most of my cases the pad presented remnants of old hemorrhages, doubtless the records of separate previous injuries.

Frequently one finds in connection with this condition an œdematous fibrous state of the synovial membrane, especially in the pouches, and it may be necessary to enlarge the incisions to remove the masses in the same way as one removes the pads. An X-ray photograph will often reveal the fibrous changes in the intrapatellar pads and also the semilunars (Figs. 26, 27, 28).

RUPTURE OF ONE OR BOTH CRUCIAL LIGAMENTS.

This is a very serious accident, and one includes the old ununited rupture amongst derangements because it involves the joint in abnormal movement. When one considers the excellent recovery which sometimes follows a complete dislocation of the knee, one realizes that recovery of useful union of the crucials should be expected. Some years ago I was called to the country to amputate a gangrenous limb resulting from an unreduced backward dislocation of the femur. On opening the joint afterwards complete rupture of the crucials was displayed. I have had under my observation several cases of dislocation of the knee. It is usually a forward displacement of the tibia due to forcible hyperextension. Several cases exhibited the opposite deformity, in some the head of the tibia lay behind and above the articular line of the femoral condyles. I have met with one case of lateral displacement of the knee, unaccompanied by fracture. My recollection of most of these cases is that useful recoveries resulted although rupture of the crucials must have occurred in all. At times, how-

ANNALS OF SURGERY

ORIGINAL MEMOIRS.

INTRAHUMAN BONE GRAFTING AND REIMPLANTATION OF BONE.

BY SIR WILLIAM MACEWEN, F.R.S.,

OF GLASGOW

Regius Professor of Surgery in the University of Glasgow.

INTRAHUMAN bone grafting is sometimes necessary to make good osseous defects brought about by disease or injury. [f]ollowing case in which the greater part of the shaft of [h]umerus was restored by intrahuman transplantation [an]d thirty years ago, and as the boy who was then operat[ed] is now a man in regular employment, the details of [the c]ase here presented in their entirety. Besides that case [o]thers are mentioned,—one illustrating human reimplan[tation o]f the flat bones of the skull and two of restoration by [transpl]antation of human jaw bones. In both of these [th]e operation was performed for the removal of marked [deform]ity as well as to restore the function of the mandible. [A fo]urth case is referred to as a note.

[T]hese cases are quoted as examples of many others in [which b]one grafting and transplantation of bone has been successfully performed by me. It is to be noted that the perios[teum pl]ays no part in the bone reproduction after transplan[tation an]d in the majority of the cases referred to the perios[teum is no]t transplanted along with the bone.

Intrahuman Transplantation of Bone. Experiment, and Result Thirty Years After.—W. C., aged 3 years, was admitted into the Royal Infirmary, Glasgow, under my care on July 17, 1878, in an emaciated and exhausted condition from suppuration in connection with necrosis of the right humerus, evidently from osteomyelitis.

He presented the appearance of a much neglected child. The right arm was greatly distended and fluctuant from shoulder to elbow. An incision gave vent to fourteen ounces of thin, fetid pus. When the abscess was evacuated, the shaft of the humerus was found to be totally necrosed and already separated from its head near its epiphyseal junction. At the condylar epiphysis crepitation was likewise elicited. The bone was dark colored and fetid.

The arm was dressed and the patient was placed on a generous diet and otherwise attended to, in the hope that his strength might improve and that he would thereby be placed in a better condition for the removal of the necrosed shaft. Notwithstanding the treatment, the daily discharge of fetid pus was great, and as the amount was not much lessened at the end of three weeks, it was considered advisable to remove the source of irritation. This was done about nine weeks after the onset of the disease.

The exposed loose bone was divided near its centre in t
parts which were consecutively withdrawn. The two h
removed comprised the whole humeral diaphysis. The urr
tube which remained was covered with a thick layer ed on
tion tissue which was soft throughout except at tl case
extremity, where the finger introduced into the tunnel de
rough, osseous plaques of bone. This tunnel was stuffe
carbolized lint and the arm was fixed on a splint. The
left by the withdrawal of the bone gradually coalesced fro
epiphyses toward the superficial openings without the forn
of new bone, except for a short distance from the head o
humerus, where about an inch and a half of shaft had fo
three months after removal of the dead shaft.

Four months after the removal of the necrosed diaph
spike-like terminal extremity was found attached to the p
portion. The measurement from the acromion process to t
of this tapered process was two inches. From the whol

ever, where union of the ligaments has not resulted an operation may be needed. Such cases have been reported by Mayo, Robson,[9] Battle [10] and by me.[11]

Robson's case is interesting, being the case of a miner who met with a severe accident in 1902, being buried in earth, and sustaining, amongst other injuries, a fracture of the leg and of ribs. After many weeks in a country hospital he was admitted into the Leeds Infirmary with a swollen knee. When the muscles were braced up the bones were in good position, but as soon as the muscles were relaxed the tibia fell back until stopped by the ligament of the patella. By manipulation the head of the tibia could be brought forward in front of the femur, and there was also free lateral movement. It was decided that not only were the ligaments generally relaxed, but that the crucials had been ruptured. When operated upon both crucials were found completely torn from their upper attachments, the ends being somewhat shreddy. They were stitched in position by means of catgut ligatures, and some years afterwards when examined, the joint had almost wholly recovered its function.

Although I have seen several cases where the diagnosis of rupture of the crucials, either anterior or posterior, was suggested, I have had an opportunity of operating upon only one case.

CASE VIII.—A barman fell down some cellar steps and dislocated his knee and for three weeks was kept at rest. He was then allowed to move about the house, and consulted me some ten weeks later. He had some pain in the knee, a little effusion, and, as he described it, "no dependence" on the joint. It slipped about, creaked, and was only moderately useful, and that only when a splint was worn. On examining the knee, the leg could be rotated inwards, but not outwards. The patient complained of pain whenever the knee was hyperextended, this being possible to a very limited extent. The tibia could be slightly displaced forwards in extension. I opened the joint by a free anterior incision, dividing the patella ligament, and found a complete rupture of the anterior crucial and considerable reddening of the synovial membrane. I freshened the ends, which were very frayed, and as they could not be brought together I plaited some chromicized gut as in nerve-union. For six weeks the patient was kept in bed, and in eight months after the operation the stability and mobility of the articulation was secured. In the

early part of last year I examined a boy of 15 who fell in scaling railings and was caught by the foot and held head downwards. I detected a separation of a small piece of bone from the inner femoral condyle at the attachment of the internal lateral ligament, and there was free mobility in all directions. It was obvious that in addition to other lesions both the crucials were ruptured. Immobilization of the joint for two months and subsequent control of the lateral ligaments resulted in a good recovery.

We may, I think, conclude that rupture of the crucials is not an uncommon incident in dislocations of the tibia and other grave lesions, and that it is amenable to mechanical treatment if such treatment be sufficiently protracted. In old, neglected cases the gliding tibia is the characteristic derangement. If the anterior crucial alone be ruptured or elongated, the leg can be displaced anteriorly, it may be hyperextended, and it can be rotated inwards.

If the posterior or stronger ligament be similarly injured, the tibia can be displaced posteriorly. If both are ruptured, the tibia can be moved backwards and forwards, and if the knee be flexed outward rotation of the tibia is increased.

DERANGEMENTS DUE TO SMALL BONY SEPARATIONS.

On six occasions I have removed small portions of bone which have remained prominent after injuries to the femoral condyles. Three of these pieces were found lying in front of the anterior crucial firmly attached—two were attached to the internal condyle and one piece embedded in the centre of the infrapatellar pad (Fig. 14). I have frequently met with fracture of a small portion of the adductor tubercle and old standing ununited fracture of the tubercle of the tibia (Fig. 15), while of separation of part of the bony attachment of the internal lateral ligament both at its femoral and tibial extremities I have several radiographs. At times these pieces of bone give rise to derangement, more especially separations from the adductor tubercle. Removal is obviously the only treatment. In recent separation of the adductor tubercle, it is well to nail it in position. The same may be said of fracture of the

tibial tubercle, which of course must not be confounded with Schlatter's disease, or partial separation at the epiphysis so common in boys. This fracture is sometimes followed by a thickening round about the insertion of the ligament (Fig. 13) painful to the touch. It is an osteitis which remains local and is most effectively treated by entering a chisel to the depth of half an inch.

FRACTURE OF THE SPINE OF TIBIA.

A rare and interesting derangement caused by fracture of the tibial spine came before me recently (Fig. 16).

CASE IX.—A man of about 40 years was thrown off a bicycle six months previously. He was laid up with severe effusion and was not able to fully extend his knee. When he consulted me, three months later, walking was difficult and recurring effusion took place, although attempts had been made under anæsthesia to straighten the limb by means of manipulation, splint and bandage, but with no success. The knee remained unable to extend by about 15°. An X-ray (Fig. 16) showed a mass of bone in the centre of the joint.

On opening the knee by the incision which I adopt for semi-lunars I came down upon the tibial spine which was displaced backwards, carrying with it the anterior crucial ligament, but surrounded by a mass of fibrous tissue. I removed the bone, leaving enough adherent fibrous tissue to enable me to fix the anterior crucial. The result is a much stronger and more useful knee, which even yet cannot be fully extended. I have had no opportunity to search the literature for such an injury, but I cannot remember ever seeing a reference to it.

RECURRENT DISLOCATION OF THE PATELLA.

During the last two years I have operated upon twelve cases of this most troublesome affection which appears to the patient the most alarming of all derangements. Practically it always occurs on the outer side.

The etiology of the displacement is suggested by the anatomical fact that the line of action of the quadriceps in the axis of the thigh differs from that of the patella ligament in

the axis of the leg (Fig. 17). When the leg is extended by contraction of the quadriceps the patella lying at the angle of the meeting of these two axes must be pulled outwards as the muscle and ligament attempt to form a sharp line. Indeed, there can be little doubt that displacement would be very frequent were it not for a second anatomical fact, viz. that the outer margin of the trochlear surface of the femur is so placed as to offer resistance to the outer deviation of the knee-cap (Fig. 4 b). In a series of cases published by Goldthwaite [12] he drew attention to what I have frequently observed, that the tibial tubercle is displaced too much to the outer side, and in this way there is an increase in the angle of axis of the leg and thigh. If we alternately extend and relax the quadriceps, this lateral movement of the patella becomes obvious and we at once note the manner in which the trochlear surface of the femur checks displacement outward of the patella. As Goldthwaite well says, " If for any reason the line of pull becomes less direct or the articular ridge less perfectly formed; if the capsule be weakened by the distention following some acute injury; if the patella tendon be abnormally long, so that the patella is drawn above the outer edge of the trochlear surface of the femur; or if the joint can be hyperextended so that during the muscular pull the patella is lifted away from the femur—in any one of these conditions, the stability of the joint so far as the patella is concerned must be materially lessened."

The symptoms of slipping patella are obvious and fairly constant. The patient, perhaps rising from a chair, feels an excruciating pain in the knee and often falls. He is unable to move. The patella is found usually on the outside of the joint; effusion of fluid follows. In the recurrent case, if of long duration, no pain accompanies the displacement and no fluid is secreted. The reduction is easily accomplished. The leg should be first extended, the inner edge of the patella be elevated and passed back to its place. Patients nearly always complain of weakness of the knees, and operative measures are sometimes needed to correct the disability. I have trans-

FIG. 14.
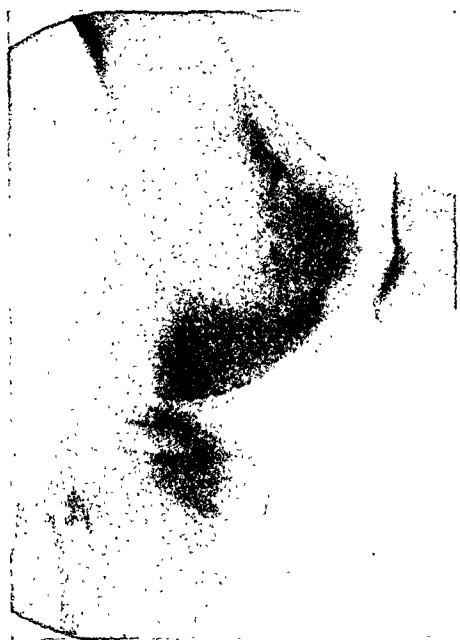
FIG. 15.

Spicule of bone separated from condyle of femur imbedded in the centre of the infra-patellar pad.

Old ununited fracture of the tubercle of the tibia.

FIG. 16.

Fracture of the spine of the tibia.

FIG. 19.
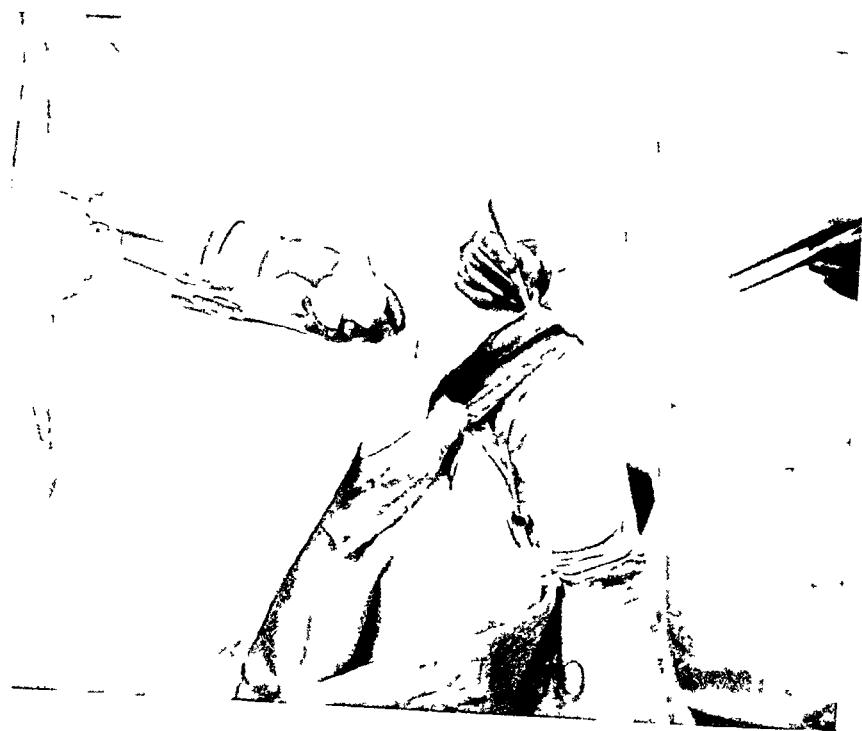
Illustrating preparations for opening the knee joint.

FIG 20.

Incision to expose internal semilunar, made with leg flexed to a right angle.

planted the tubercle of the tibia into such a position as to make
the axis of the ligament and quadriceps one. In genu valgum
accompanied by displacement of the patella I have performed
a femoral osteotomy and maintained a strong extension in a
small child. I have cut down upon the inner side of the

FIG. 17.

FIG. 18.
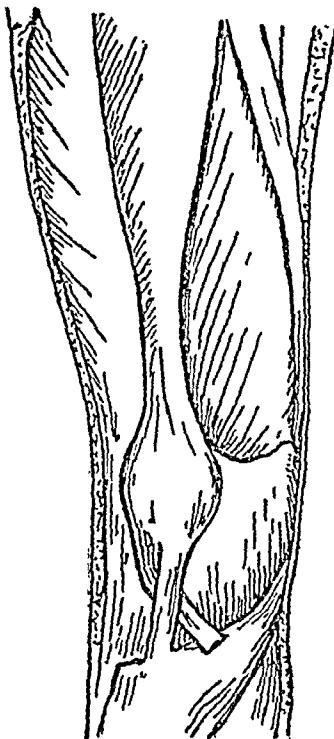
capsule and seized it above and below by a pair of Kocher
forceps. The forceps are simultaneously twisted and a longi-
tudinal strip of capsule is plicated which draws the patella
inwards; this plication is freshened and stitched without open-
ing the joint. In one obstinate case complicated by genu
valgum I divided the femur above the joint, transplanted the
tibial tubercle to the inner side, and plicated the capsule. The
best operation, however, in the uncomplicated case, is that

devised by Goldthwaite, who splits the patella tendon, and after detaching the outer half, passes it behind the remaining portion and implants it to the inside of the patella tendon. The tendon is stitched to periosteum and to the expansion of the tendon of the sartorius muscle (Fig. 18), and in addition I plicate the capsule on the inner side. The operative treatment should only be advised in the really troublesome case.

OPERATIVE TREATMENT OF SEMILUNARS.

As I have said elsewhere, there can be no greater tragedy in surgery than to infect a knee joint in operating for a derangement. In my early days I experienced one such tragedy which ended in death. Although since then I have opened the knee for mechanical derangement in considerably over 500 cases, I always approach the operation with the most rigid care. Obviously the greatest precautions should be taken whatever operation be performed on any part of the body, still, the slightest error in technic in removing irritant bodies from the knee will almost surely end in disaster. As Edmund Owen says, " the knee joint leaves no margin for mistake,"— in this respect it is so different to the abdomen. Before our precautions were as careful as they are, I had several cases, perhaps five or six, with reddened skin which caused anxiety but ended well. In others I operated for tense and painful effusion. In no case was there any serious trouble nor any loss of subsequent mobility.

Whoever undertakes to operate should be scrupulously clean; he should pay, not homage merely, to asepticism, but allegiance. I prefer to have the knee cleaned with soap and water night and morning for a full week and compresses of sterile water covered with mackintosh applied. On the evening before operation the knee is washed with ethereal soap followed by methylated ether, and is finally rubbed with biniodide of mercury, water and alcohol, 1 in 1000, dried with sterile wool, and a dry sterile dressing applied. On the operating table in the morning I conduct a final scrub with mercury and alcohol 1 in 500, quickly followed by a rinsing with sterile

Osteoma of tibia invading joint.

FIG. 24.

FIG. 23.
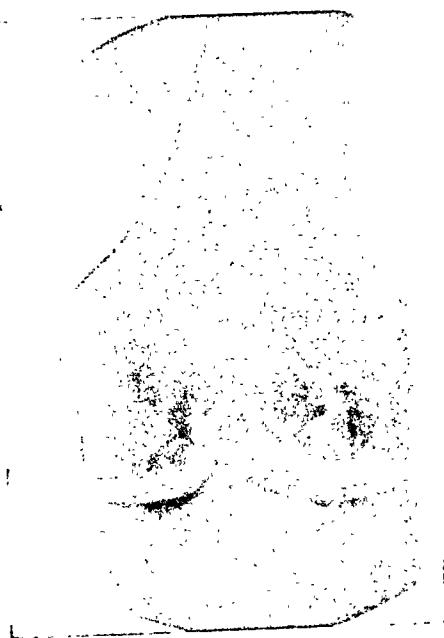
Detachment of bone with rupture of internal
lateral ligament.

FIG. 25.
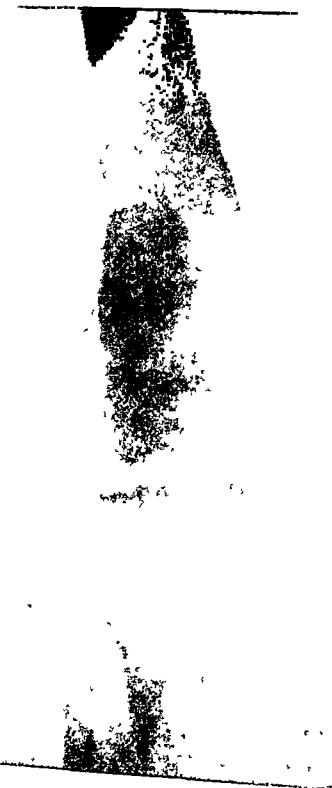
Detachment of portion of articular surface of
femur, locking joint at angle of 45 degrees.

FIG. 26.

Knee distended with oxygen to show semi-
lunar cartilages.

FIG. 27.

Joints distended with oxygen showing semi-
lunars.

FIG. 28.

Joint distended with oxygen to show thickened
infrapatellar pad.

water. The nurse, if she has to do with the sterilization of the knee, should be herself free from infected hands. She should not have touched a doubtful case for days. Both when the knee is washed and at a later stage, when chemically sterilized, the nurse must wear india-rubber gloves, boiled for each occasion; less than this is not enough. The surgeon's hands should be thoroughly prepared, first in running water and then with spirit lotion. Ten minutes at least should be spent in the rougher cleansing before a germicide is used. When the hands are as clean as water and lotion can make them, the antiseptic conscience will still distrust, and the surgeon must make assurance doubly sure by wearing boiled rubber gloves. Every one in the theatre should have head and mouth well covered, and a sterile gauze screen should be placed between the patient's face and the field of operation.

For some time I have given over operating with the knee in such a position that it has to be further flexed during the proceedings. Unless the greatest care is taken, the cloths get shifted or air is introduced into the joint. All surgeons of experience will have noted this. To avoid this risk I begin the operation with the patient's knee hanging at right angles over the foot of the table (Figs. 19, 20). To shift during the operation is to change the plane of the incision. The final cleaning of the knee takes place while the joint is flexed and the skin tense. Some thicknesses of sterile gauze squeezed out of 1 to 1000 biniodide of mercury is wrapped round the joint and the incision is made through the gauze, the cut edges of which are fixed to the wound. The length of incision which practically always suffices is three inches, the incision into the capsule is much smaller (Fig. 20). Long skin incisions obviously add to the risks, and are only very exceptionally needed. The incision should be slightly curved and extend from an inch within the lower angle of the patella to half an inch below the tibial margin, curving more acutely at this point towards the lateral ligament. The interior of the joint is then inspected with the aid of carefully applied retractors. No less authorities than Sir William Bennett [4] and Mr. Whitelocke [5] advocate

entering the finger for exploratory purposes. The finger should never enter the joint. Neither the surgeon nor the assistants should touch the wound with anything but sterile instruments. The sutures for the capsule should be handed on forceps and I usually make the stitches a blanket-stitch. In the flexed position, the best view is obtained of the interior of the joint and the cartilage can be well inspected. If the capsule plicates and hides the view, draw it outwards with a skeleton retractor which may be used to obtain a good view in any direction. The cartilage may be found in any position. It may be detached at its anterior extremity. It may be circumferentially split; it may be completely fractured; it may . be completely twisted; it may be firmly fixed but with frayed inner border; it may be nodular; the posterior part may be in front; it may be attached at its extremities and free along the whole or part of its outer border; the anterior part may be ground away, or found quite loose as a separate body, or only the slightest movement may be possible, due to a loosening of its moorings. The examination, which should be gentle, is facilitated by a sharp or blunt hook. It is only necessary to remove the loose portion of cartilage, be it a frayed border, a circumferential tear or a detached anterior portion. Here I would offer a practical suggestion. Never pull upon the cartilage nor cut when pulling; this detaches more, and to my knowledge is a cause of recurrence. Note the degree of detachment and go a short distance further with a knife cutting the cartilage clean across, and then complete the incision along the outer border. Having removed the cartilage, look for fringes, tabs or other possible agencies which may cause trouble in the future, and remove them. Stitching the cartilage should be an obsolete operation. If the cartilage is only slightly mobile and the history characteristic, it should be removed forthwith.

During the operation, dabs taken directly from the sterile drum should cover the wound during any interval, and no dab should be used which has been exposed to the air.

I never tie vessels, always use a tourniquet until the dress-

ings are bandaged, and never drain. I used to drain, years ago, but I consider it quite unnecessary, and an additional communication between skin and joint. The synovial membrane capsule and skin should be separately sutured and the sutures should not pass through the whole thickness of the skin.

I now know no anxious moments, the skin never reddens, nor do I have trouble with effusion.

The stitches are left in position for eight days, the knee kept slightly bent in a splint for the same period, or a few days longer, and then passive movements and massage are started. Special attention should be paid to the weak quadriceps and in from three to four weeks normal exercise should be allowed.

REFERENCES.

[1] Tenney: ANNALS OF SURGERY, 1904, xl, p. 1 (Anatomy of Knee and Bibliography).

[2] Hoffa: Berlin klin. Wochenschr., 1904, xxi, 43.

[3] Griffiths: Brit. Med. Jour., 1900, ii, 1171.

[4] Sir Wm. Bennett: Injuries and Diseases of the Knee Joint, 1909.

[5] Whitelocke: Injuries to Joints, 1907.

[6] Arbuthnot Lane: Clin. Jour., London, 1900, xvi, p. 103.

[7] Larrey: Bulletin de la Soc. de Chir. de Paris, 1861, p. 3ç8.

[8] Tenney: ANNALS OF SURGERY, 1908, xlviii, 714.

[9] Robson: ANNALS OF SURGERY, xxxvii, p. 716.

[10] Battle: Trans. Clin. Soc., London, xxxiii, p. 232.

[11] Jones, R.: Clin. Jour., London, 1906, xxviii, p. 51.

[12] Goldthwaite: ANNALS OF SURGERY, 1899, xxix, p. 62.

PARTIAL HYPOPHYSECTOMY FOR ACROMEGALY.*

WITH REMARKS ON THE FUNCTION OF THE HYPOPHYSIS,

BY HARVEY CUSHING, M.D.,

OF BALTIMORE.

Associate Professor of Surgery in Johns Hopkins University.

RAPID advances in our knowledge of the physiology and pathology of the thyroid gland followed on the heels of the early surgical experiences, showing the danger of total extirpation of goitrous tumors which, after the example of Kocher and Reverdin, were being subjected to operation at the hands of many. In some cases an acute disturbance (cachexia strumipriva) supervened; in others, a chronic state of malnutrition, which was soon recognized as identical with the condition "myxœdema," to which Sir William Gull had called attention.

These early clinical observations provoked studies which led to the discovery of the separate function of the thyroid gland and the parathyroid glandules of Sandström and Gley; to an understanding of the clinical manifestations not only of hyper- and hypothyroidism, but of tetany as well; to the modern methods of partial thyroidectomy for cases in which the gland is hyperactive and to organotherapy for conditions of deficient activity—one of the triumphs of experimental medicine.

Surgical experiences will doubtless come to play a similar rôle in helping to untangle the complexities of the functional disturbances of hypophyseal origin. Surgeons, however, cannot afford to enter into this new field too precipitously, not simply by reason of the peculiar inaccessibility of the gland—for operative resources will overcome these difficulties—but principally on account of the present uncertanties

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in regard to its physiological properties. We at least should profit by the lessons taught us by the earlier experiences with the operations on the thyroid, undertaken before there was a full understanding not only of the clinical consequences of total extirpation but also of the double glandular function (thyroid and parathyroid).

Surgery of the hypophysis up to the present time, with the possible exception of the case that I am about to report, has been limited solely to an attempt to remove tumors or to evacuate cysts originating either in the gland itself or in its immediate neighborhood—a period in the development of these matters comparable to the early chapter in the history of the thyroid when operations were restricted to the removal of goitrous cysts or tumors which were causing pressure symptoms. Beyond question, however, as was true of the thyroid, there will prove to be innumerable instances of more or less pronounced over-activity of the hypophysis, as well as cases of under-activity, *unassociated* with tumors; and it is necessary, before we can establish any rational basis for treatment, that we have a clearer understanding of the clinical manifestations of these states. This applies not only to surgical measures but to organotherapy as well,—for the administration of the gland or of glandular extracts, in the light of our present knowledge, must still be carried out most blindly.

I shall endeavor in this communication (1) to state briefly the existing views in regard to the rôle of the hypophysis in disease; (2) to recount the few facts which are known concerning the function of the gland; (3) to give the bare results of our own experimental work, which has served in a measure to throw light on the condition of hypophyseal deficiency (hypopituitarism); (4) to report a successful case of partial hypophysectomy for acromegaly (hyperpituitarism); and (5) to discuss the lines along which surgical measures must in the future be directed.

1. *Hypophyseal Diseases.*—To review an old story, the peculiar symptom-complex to which the name acromegaly was

given was described in 1886 by Pierre Marie; and a few years later he expressed the view, based on the post-mortem findings in certain cases, that the malady was associated with a definite enlargement of the pituitary body, either a hyperplasia or an adenomatous growth. Since then gigantism has come to be regarded as an allied condition dating from youth and likewise associated with tumor or enlargement of the gland. These observations have been followed by innumerable reports, some of them confirmatory, others opposed to Marie's view; for there have been cases of acromegaly recorded in which the hypophysis is said to have shown no pathological change, and a particularly large number of cases in which tumors of the gland or its neighborhood have been *unaccompanied* by symptoms of acromegaly.

A review of many of these latter reports, together with the study of certain patients seen in the clinic of Frankl-Hochwart, led Fröhlich to the view that a certain definite syndrome associated with adiposity and arrested sexual development was characteristic of a number of these cases of hypophyseal tumor in which manifestations of acromegaly were absent. Renewed interest in the surgery of the hypophysis followed Schloffer's proposal of a transphenoidal approach to the gland, and a few of these patients with this syndrome have since been operated upon by von Eiselsberg and others, with evident amelioration of the symptoms.

As yet, however, there has been no corroborative experimental proof of the relation either of the syndrome of Fröhlich or that of Marie to any definite alteration of the gland—far from any determination as to whether such histological alterations as have been found represented a condition of over- or under-activity. Indeed, I have been unable to gather from the writings of Marie and his associates whether, in the light of conjecture, they finally came to regard acromegaly as due to under-secretion or over-secretion of the affected gland or one of its subdivisions.

In Hochenegg's successful case of operation for acromegaly the striking shrinkage of the tissues involved in the

over-growth led Stumme, who made the full report of the case, to the natural supposition that the condition represents one of hypophyseal over-activity comparable to the over-activity of the thyroid in exophthalmic goitre. However, the marked improvement which has followed similar opera- · tions with partial extirpation of hypophyseal tumors associated with the syndrome of Fröhlich in the absence of acromegaly, has led to further confusion as to the actual part played by the pituitary body in these dissimilar states.

2. *Hypophyseal Function.*—Marie's clinical observations stimulated physiologists to a renewed interest in the gland, and it was found by Howell that the posterior lobe (pars nervosa) contained a blood-pressure raising principle and by Schäfer that a substance producing diuresis was present in the same part of the gland. Here the matter has remained practically stationary so far as the results of injections are concerned.

Since Horsley's brief statement in 1886 to the effect that he had removed the hypophysis from a few dogs without appreciable effect, there have been endless reports of investigations on animals of various species by divers operative procedures which have left the question of extirpation and its consequences a most unsettled one. Some have claimed that removal of the gland is incompatible with life; others that its loss has no effect on the physiological status of the animal whatsoever. A series of successful extirpations in dogs by a new operative method, however, has led Paulesco to emphasize again that the gland is essential to life; for after a total hypophysectomy all of the animals succumbed in the course of a few days to a definite train of symptoms (cachexia hypophyseopriva) ; a fragment of the gland, on the other hand, was found to have been left *in situ* in all of the animals which survived.

3. *Experiences with Experimental Hypophysectomy.*—In association with Dr. S. J. Crowe and Dr. John Homans an extensive series of observations has been made during the past year which has led us to fully support the main conten-

tion of Paulesco; namely, that at least a fragment of the gland is essential to the long continuance of life. All told, there have been over one hundred of these operations on the canine, carried out by a method very similar to the bilateral craniectomy used by Paulesco.

It is, however, upon the disturbed equilibrium of the animals that were observed for a long period after *partial* removal of the gland that I particularly wish to dwell. A number of these dogs, though kept under the same laboratory conditions as control animals, have in the course of a few months become excessively fat, and in every instance have shown marked atrophy of the organs of generation—a combination of symptoms, therefore, comparable to the clinical states of adiposity with infantilism described by Fröhlich.* It may be added that these symptoms are associated with deficiency of the anterior lobe alone and seemingly bear no relation to extirpation of the pars nervosa, though all the physiological activities of the gland hitherto recognized through injection methods are confined to this lobe. Alterations at the same time in the other ductless glands of the body are more or less constant after these partial hypophysectomies, showing the close interrelation of all of these structures—matters, however, which cannot be touched upon here.

Fully realizing that there is much that remains to be explained in regard to the function of each of the three divisions of the pituitary body, we nevertheless have been bold enough on a recent occasion,† as the result of our experiments, to advance certain views in regard to hypopituitarism and hyperpituitarism so far as the anterior lobe is concerned. Since then, through the kindness of numerous professional friends,

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* There have been many other associated symptoms, which are beyond the scope of this paper—polyuria, glycosuria, amenorrhœa, impotence, etc.—all of them frequent accompaniments of the clinical conditions, whether acromegaly, gigantism or the adiposogenital degeneration, which are met with in company with hypophyseal tumors.

† The Hypophysis Cerebri: Clinical Aspects of Hyperpituitarism and of Hypopituitarism. The Oration at the Sixtieth Annual Session of the A. M. A. Jour. of Am. Med. Assn., July 24, 1909, vol. liii, p. 249.

the opportunity has been given of seeing several cases, particularly of hypopituitarism, many of them, in all probability unassociated with tumor.

I have purposely refrained in this brief discussion from making comment on the neighborhood symptoms of tumor in the hypophyseal region, though our diagnoses in the past have largely depended upon their presence; for I especially wish to emphasize the fact that conditions of hyperpituitarism and of hypopituitarism of greater or less degree doubtless occur frequently in the absence of tumor—as frequently, in all probability, as the corresponding disturbances in the secretory activity of the thyroid gland.

Had it not been for the presence of tumor or hypertrophic enlargement which definitely pointed out the seat of war it is improbable that we should have come to associate acromegaly or the syndrome of adiposity and sexual infantilism with a lesion of this hitherto obscure gland, particularly in view of the fact that our familiarity with its histological appearance in states of over- or under-activity is slight when compared, for example, with our knowledge of the finer anatomy of the thyroid under like conditions.

Though it must be considered merely as a working basis at present, it is my impression that the cases of the group Marie, with hyperplasia or the adenomatous condition which he and Marienesco describe, represent a state of over-activity (hyperpituitarism); whereas the cases in the group Fröhlich represent a condition of lessened activity (hypopituitarism) in consequence of invasion or compression of the gland by the tumor or cyst, on whose presence the diagnosis of the condition has heretofore rested.

The natural explanation of the improvement in the symptoms due to disturbances of glandular function (apart from the pressure or neighborhood symptoms) which has followed the evacuation of cysts or partial tumor extirpation in the cases of the Fröhlich type is, that remaining fragments of the anterior lobe have resumed their normal function, being relieved from pressure as a result of the operation.

Summary.—It may be said, therefore, that we have experimental evidence that a condition of adiposity with loss of activity or with definite atrophy of the sexual organs may follow the removal of a large part of the anterior lobe of the pituitary body. Hence it would seem probable that the syndrome Fröhlich is likewise a condition due to hypopituitarism.

Further, the experimental evidence is fairly conclusive that the sudden removal in its entirety of the epithelial lobe (pars anterior) of the hypophysis during a presumed state of health is incompatible with a lengthened maintenance of life— a matter of evident surgical moment in the treatment of hypophyseal lesions.

Finally, an additional case of operation for acromegaly in which, for the reasons which have been given, the gland was purposely removed only in part, will be fully recorded. It adds further support to the view of Stumme and the conjectures made by others in the past that acromegaly (gigantism likewise) is a condition due to over-activity of the gland (hyperpituitarism).

4. *Partial Hypophysectomy for Hyperpituitarism (Acromegaly)*. CASE.—The patient, J. H., a farmer aged 38 years, kindly referred to me by Dr. Charles H. Mayo, entered the Johns Hopkins Hospital in March, 1909. He complained of frontal headache, photophobia, thickness of speech from an enlarged tongue, and increase in the size of the jaw, hands and feet.

The *family history* is good and apparently has no bearing on the case.

Past History.—Patient has always regarded himself as healthy. No illness recalled with the exception of mumps at 24, a severe attack of quinsy at 32, whooping-cough at 33, and measles when 34 years of age.

He has been married seven years and has one healthy child 5 years of age. He is not impotent but has had little sexual appetite for a year or more—a condition which he attributes to his discomforts. His average weight has been of late years 175 pounds and he has gained about 10 pounds in the last few months despite his discomforts.

Present Illness.—About eight years ago he began to suffer from periodic headaches, which have increased in frequency and severity so that now the pain has become more or less constant, with exacerbations. It is referred to the depth of the head and often passes to the back of the neck, where there is considerable stiffness and an uncomfortable drawing sensation. Soon after the onset of the headaches he began to be troubled with photophobia, particularly during the attacks of pain. Otherwise there has been no visual disturbance; no history of scotomata, squint or diplopia. There has been no impairment in hearing, no olfactory or gustatory disturbance, no vomiting, no nausea.

It was pointed out to him several years ago by his friends that his lower jaw and lips were increasing in size. The subsequent enlargement has been so gradual that the change has hardly been noticeable though he is aware that his entire head, his hands and feet have shared in the growth. Eight years ago he wore a number seven shoe and at present a number eight is rather too small and he requires a larger hat than formerly.

He has had some difficulty with mastication, owing to the failure of the teeth to meet, but the face has not felt stiff and expressional movements seem normal. Speech has become somewhat husky owing to the enlarged tongue.

He complains of dizziness on resuming an erect posture after stooping; also of numbness and tingling of the hands and feet, which are cold and clammy. He suffers from cold, particularly in winter, when his fingers look like " dead fingers." During the past two years he has felt weak and worn out through constant pain, and has been pretty much confined to the house during the daytime owing to his photophobia. His bowels tend to be constipated; there is no history of glycosuria or polyuria.

Physical Examination.—A well-nourished, muscular man. The general color is dusky, cyanotic, possibly due to prolonged indulgence in antipyretic drugs.

Head.—The characteristic features of acromegaly are evident in the accompanying photographs (Figs. 2, 3, and 9). The largest horizontal circumference of the cranium is 61 cm. The jaw is markedly undershot, although without widening of the mandibular arch. The teeth, as far forward as the second bicuspids, meet fairly well, but from here the lower dental arch projects beyond the upper fully 1 cm., the possible change of

position varying from 8 to 11 mm. The mouth can be opened at the widest only 4 cm. and the subjective sensation of stiffness is marked. There is considerable projection of the supra-orbital arches, evidently due to enlargement of the frontal sinuses.

Eyes.—Pupils are equal and react normally. The ocular movements are normal, though strong convergence causes discomfort. The sclera are slightly injected. The eyes are somewhat tilted, giving a slightly Mongolian aspect to the face. A perimetric examination shows normal fields for form and color.

Ears and hearing are normal, also sense of smell. The nose is large and broad, the lips thick. Nothing abnormal is shown in pharynx or tonsils. The tongue is large, thick and coated. The teeth are widely spaced (Fig. 3).

The thyroid is not appreciably enlarged. A few small glands in the right side of the neck and the epitrochlears are palpable.

The thorax is barrel-shaped, the costal angle about 85°. There is evident enlargement of the sternum, and the clavicles are large and prominent with unusual curvature. The chest is abnormally thick and the characteristic sloping of the shoulders with prominence of the upper spine is present. The heart and lungs are negative and there is no evidence of arteriosclerosis in the palpable vessels. Nothing abnormal is apparent in abdomen, abdominal viscera, or genitalia.

The hands and feet are large (Figs. 2 and 8), with the usual spade-like appearance due to the periosteal thickenings typical of the disease and shown by the radiogram (Fig. 4). Elaborate measurements of the fingers taken throughout show the largest circumference of the middle finger to be 8.5 cm. The hands are supple and strong, the nails normal and without ridging. The foot measures 26.5 cm. in length, the circumference of the great toe being 10.5 cm. The soft tissues of the hands, as well as of the face, feel dense as though distended with a solid œdema, which, however, does not pit on pressure.

The blood and urine are normal: no polyuria; no sugar.

A lateral radiogram of the skull shows clearly a slight enlargement of the sella turcica (Fig. 5).

Operation, March 25, 1909.—Preliminary tracheotomy; partial removal of the hypophysis, using transphenoidal route and osteoplastic resection of anterior wall of frontal sinuses. Closure of tracheal wound without drain. Ether anæsthesia (S. G. Davis).

FIG. 1.

The patient some years before onset of symptoms.

FIG. 2.
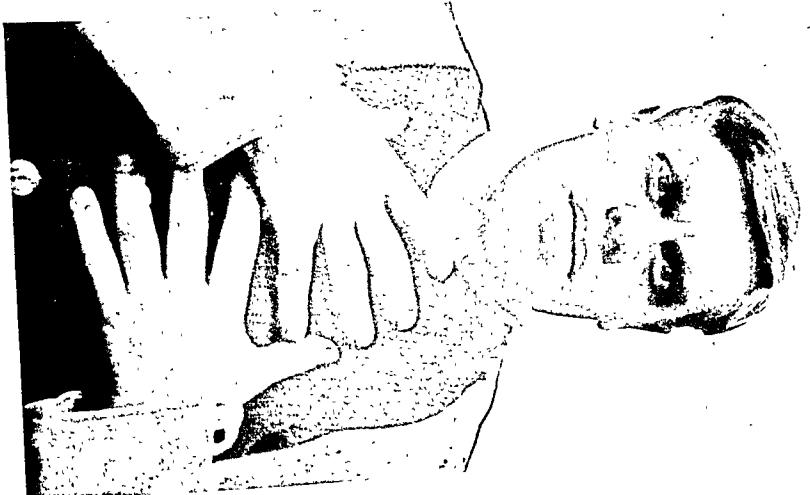
Condition on admission. (For comparison with Fig. 1.)

X-ray showing usual bony changes. Note thickness of soft parts.

Condition before operation—photophobia. Note spacing of teeth, under-
shot jaw and thick lips.

Fig. 5.
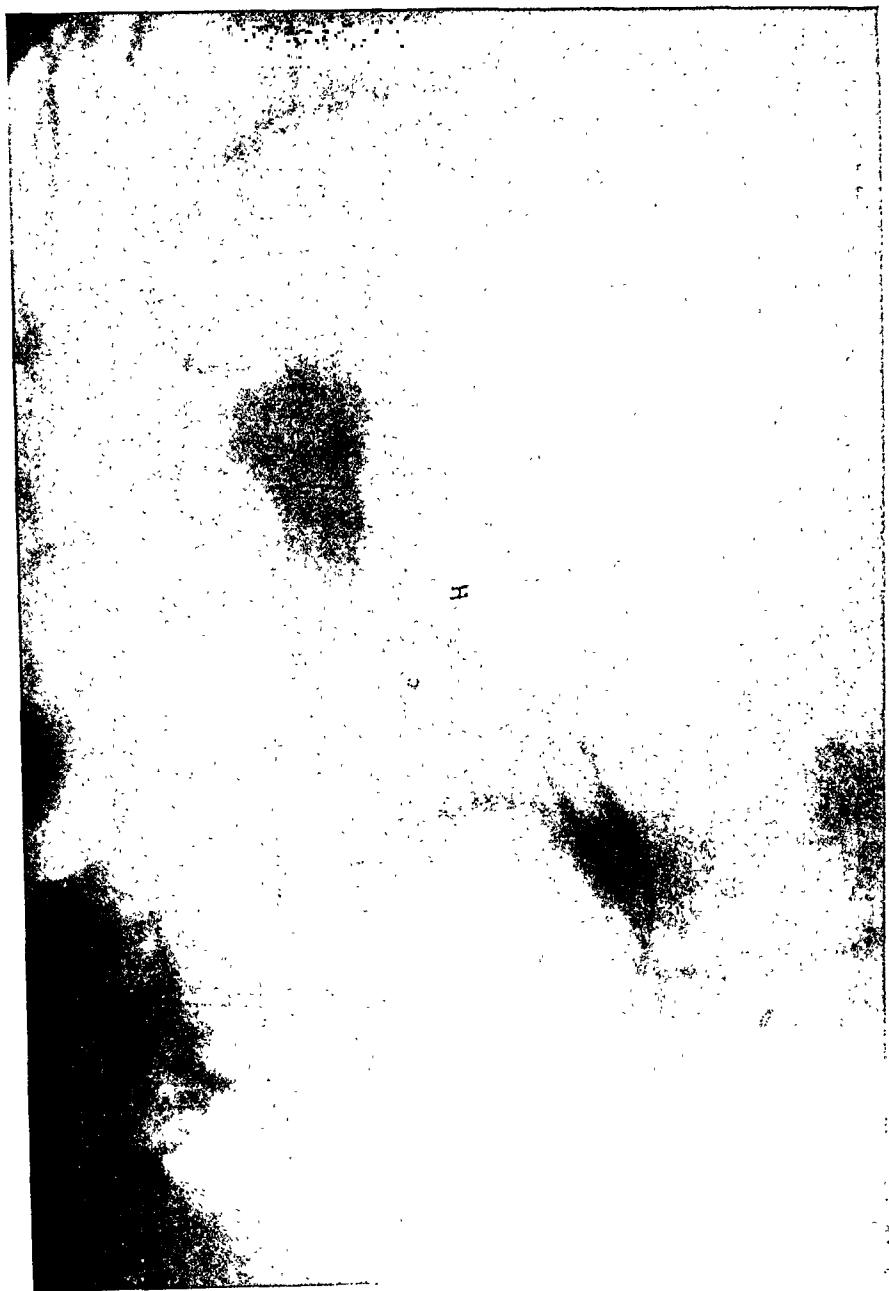
Showing sella turcica slightly enlarged, *H*. (Size—two-thirds of original.)

FIG. 7.

Three months after operation. (For comparison with Fig. 6.)

FIG. 6.

Fourteen days after operation. (To show situation of incision.)

FIG. 8.

Right hand two weeks after operation, showing subsidence of " œdema " with wrinkling of skin.

Three months after operation. Note considerable change in profile.

Characteristic profile of acromegaly—condition before operation. (For comparison with Fig. 10.)

During the twenty-four hours prior to the operation four 15-grain doses of urotropin had been given. Possibly owing to the large tongue great difficulty was experienced in bringing about a state of surgical anæsthesia, and fearing complications from this source tracheotomy was performed. The trachea was exposed after division of the thyroid isthmus and removal of a section of the gland for histological purposes. The trachea was found filled with frothy mucus, which doubtless would have given trouble during the course of the operation. Warmed ether vapor was subsequently administered through the tracheotomy tube which was inserted through a transverse opening made between the second and third cartilaginous rings—a form of opening most suitable for immediate closure.

To prevent the entry of blood into the pharynx the posterior nares were then occluded with a sea-sponge held in place with a tape emerging from the nose in the usual way. The patient was then placed in the position of Rose; both nares were swabbed with a small amount of 10 per cent. adrenalin solution, and the sella turcica was approached as follows:

An omega-shaped incision (apparent in the photographs, Figs. 6 and 7) was made over the region of the frontal sinus, the lower legs of the incision converging toward the inner angle of the orbits whence they were continued down along each side of the nose to the lower margin of the nasal bones.

With a perforator and burr primary openings were made entering the outer side of each frontal sinus; a communication was made between these openings through which a Gigli saw was passed, and the upper edge of the proposed frontal sinus flap was cut from within outwards. Then with Montenovesi forceps the lateral incisions of the proposed frontonasal flap were carried downward through the nasal bones to their inferior margin in correspondence with the original skin incision. The median septa were divided with a few strokes of a thin-bladed chisel and the flap, consisting of anterior wall of the frontal sinus with the divided nasal bones and overlying soft parts, was broken loose and reflected downward.

The inner aspect of the enlarged frontal sinus, thus exposed, was roughened and contained many small mushroom-like, bony projections. The lining membrane appeared normal.

The ethmoidal cells were then carefully rongeured away until

a mesial channel possibly 2 cm. in diameter was made just below the ethmoidal roof and carried well back toward the posterior part of the nasal fossa. A head-light was then employed and the position of the sphenoidal cells easily determined. Their anterior wall·was broken down, and on the upper and posterior aspect of their cavity the characteristic median projection of the sella turcica into these sinuses was easily detected. The thin shell of bone was chipped away with delicate strokes of a narrow chisel, exposing the spherical pocket of dura which envelopes the gland. This dural pocket was very tense and, judging from our experiences on the cadaver, was somewhat larger than normal. It was incised longitudinally and a considerable portion —possibly one-half of the exposed gland—was removed piece-meal with the aid of a delicate, long-handled curette.

Two small cigarette drains of protective were placed from the region of the sphenoidal cells, one emerging from each nostril. The frontonasal flap was replaced and secured in position by a layer of buried sutures approximating the divided frontalis muscle and galea. .The tracheal wound was then closed without a drain, four fine black silk sutures being used to approximate the edges of the transverse incision, and another, later, for union of the divided thyroid isthmus. The sponge was then withdrawn from the posterior nares.

At no stage of the operation was there any disturbing loss of blood, and at no time was the operator's view submerged— possibly owing to the adrenalin. It was surprising to find how small an opening had actually been made through the ethmoidal region and how accessible the sella turcica actually proved to be after the landmarks had once been well determined.

The urotropin was continued for several days after the operation and there were no postoperative complications whatsoever. The external wounds healed *per primam*. The last nasal drain was withdrawn on the third day; the sutures were removed and the flap supported by a collodian dressing. The patient was up three days after the operation. From the first there was prac-tically no discharge from the nostrils. An immediate subjective sensation of well-being followed the operation, with complete and permanent disappearance of the headache from which he had suffered so long.

Though anxious to return home and quite able to leave the

hospital within a week or ten days after the operation, he was persuaded to remain for seventeen days, *i.e.*, until April 11. During this interval he had called our attention to the fact that his hands seemed much less stiff than formerly; indeed, that he had not seen wrinkling of the skin such as was present for a number of years. The photograph' (Fig. 8) was taken at this time in order to show this condition. There was no question but that the peculiar objective thickening of the tissues was much less marked than before. Measurements of the fingers showed that they had diminished 1 to 1.5 mm. in their circumferential measurements. His photophobia had almost entirely diminished. The one objectionable feature was the inevitable complete loss of his olfactory sense.

The patient returned to his home on a farm in the West, and after actively participating in harvesting returned to us for observation, at our urgent appeal, ten weeks later. At this time (June 24) it was quite apparent that considerable change had taken place in his appearance (*cf.* photographs, Figs. 7 and 10), seemingly due to lessened density of the tissues of face and lips. Some of the measurements seemed altered for the better. The teeth could be separated 4.5 cm. The anteroposterior movement in the lower jaw beyond the margin of the upper teeth was from 7 mm. to 11 mm. The teeth seemed to be less widely spaced. The circumference of the head was 60.5 cm. Other slight measurable alterations were made out, which possibly lay within the margin of error, so that it would be unjust at this early date to lay emphasis upon them. Before the operation my assistant, Dr. G. J. Heuer, had made an excellent plaster mask of the head and casts of the hands, which will enable us to make accurate comparative measurements in the future.

There had been no headache since the operation, very slight photophobia and only an occasional slight puffiness of the hands —much less than formerly. The speech still remained somewhat thick and the patient had no subjective consciousness of any diminution in the size of the tongue comparable to that which had occurred in the soft parts of the hands. There had been no nasal discharge. He was troubled only by the loss of the sense of smell, which had cut him off from the enjoyment of certain flavors. He had given up smoking, and now chews tobacco, and no longer cares for coffee. He had gained ten pounds in

weight, but we trust that the amount of anterior lobe removed was not sufficient to produce symptoms of physiological deficiency.

The histological examination of the fragments of anterior lobe removed correspond with what we regard as a condition of glandular activity—a matter to be reserved for a forthcoming communication.

The photographs (Figs. 7 and 10) show the absence of any operative deformity.

5. *Operative Methods.*—The various routes which have been suggested as available for an approach to the hypophysis are too well known to surgeons to necessitate or justify their being reviewed here, nor is it the purpose of this paper to do so.* There are, however, certain points in regard to these procedures in general on which a personal comment may be called for.

In the first place, most, if not all, of the operations in the past have been done for *tumors* originating in the gland itself or arising in its immediate neighborhood. These tumors, as I have endeavored to show, may be associated with evidence of hyperfunction, as in acromegaly, or, in patients showing the syndrome of Fröhlich, with hypofunction. In the presence of a tumor the main surgical indication is of course the removal of the growth, with preservation of some of the normal gland if possible, and if the tumor happens to lie well above the sella turcica so that it is visible from the side, the most natural method of approach is that which has been followed by Horsley in his series of cases; namely, a temporal and intracranial route. I have attempted to follow this route in the case of an adult woman with all the characteristic local symptoms of hypophyseal tumor, accompanied by great adiposity and amenorrhœa (hypopituitarism). Though the infundibular region was easily brought into view the tumor did not project above the dural margin of the clinoid processes,

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* Comprehensive reviews of the purely surgical aspects are to be found in the " Sammelreferat," by Ernst Venus, in the Centralbl. f. d. Grenzgeb. d. Med. u. Chir. of this year, and in Proust's article " La chirurgie de l'hypophyse," in the Journal de Chirurgie, 1908, vol. i, p. 665.

and further investigation would have been foolhardy. The patient refused a subsequent transphenoidal operation which was proposed.

Nevertheless, in all of our experimental canine operations we have successfully used this intracranial method, combining it with a generous opening over the opposite hemisphere to allow for the important principle of cerebral dislocation; for with this precaution the temporal lobe on the side of the approach can be elevated without danger of compression or risk of cortical injury, since ample room for the necessary manipulations is allowed by the protrusion of the opposite hemisphere through the overlying defect in bone and dura. By this procedure the canine gland can be lifted out of its shallow envelope and, dangling in plain view, can be dealt with as desired. This, unfortunately, is not true of the human gland, and the temporal operation in all probability must remain restricted in its use either to those cases in which a benign tumor (*e.g.,* of the teratoma type described by Hecht and myself) or a hypophyseal cyst projecting into the infundibular region, can be brought into view and attacked from the side. It may prove useful, therefore, as in the case just cited, as a preliminary measure to be used for orientation of the growth before the final plan of attack is decided upon.

If, on the other hand, the lesion occupies the sella turcica and is confined within an intact though possibly distended pocket of dura, an approach from one side, as so many have pointed out, is most hazardous; if not well nigh impossible; and it is in these cases that the transphenoidal operations naturally become the ones of choice. In some instances, indeed, as in the case described by Erdheim, the tumor may actually project into the sphenoidal cells rather than into the cranial chamber. All operations, however, which open up the cranial base after traversing the nasal fossa are prone to be followed by meningeal infection, and this as much as anything else has been the element which has deterred surgeons from eager acceptance of Schloffer's operation. After all, by whatever method of approach they may be attacked little

can be expected of an operation for an epithelial tumor of the gland, beyond the temporary palliation of pressure symptoms, for at best their removal from this inaccessible region must be fragmentary and incomplete.

Now, leaving the tumor question aside and considering the probability that surgeons may be called upon in the future to treat certain of the conditions associated with alterations in the pituitary gland which are not necessarily accompanied by great enlargement, there can be but little doubt that the transphenoidal route will be most often followed. Of the various modifications of this operation a direct median approach through the nose is not only far less mutilating than any other midline operation, such, for example, as the intermaxillary or bucconasal procedure suggested by Gussenbauer and König, but also possesses the advantage over any lateral route, whether transmaxillary or intranasal, in the lessened likelihood of missing the situation of the mesially placed gland. The important factor seems to me to be a direct extracranial midline approach by the shortest possible route.

There are a number of modifications of Schloffer's nasal procedure, with either a mesial or lateral reflection of the nose, with or without opening of the frontal sinuses and with or without removal of more than the median septum and cells of the ethmoid. Schloffer in his first case deflected the nose to the side, sacrificed the internal wall of the orbit as far as the optic nerve and likewise the internal wall of the maxillary. As has been true of the attempts to reach the Gasserian ganglion, more heroic measures have naturally been employed in the earlier operations than have since proved necessary, and the method first carried out by Schloffer will doubtless undergo as many modifications at the hands of subsequent operators as the Hartley-Krause operation has undergone. For a time presumably no two individuals will approach the gland in exactly the same way, and whether it is desirable to combine, after the method attributed to Giordano, a temporary osteoplastic resection of the anterior wall of the frontal sinuses together with the osseous portion of the nose, or indeed

whether this is practicable in conditions other than acromegaly, in which the frontal sinuses are apt to be enlarged, must be left for future determination.

Hesitation to accept the transphenoidal operation on the grounds of possible meningeal infection will be lessened in the future in view of Crowe's discovery of the rapid appearance of formaldehyde in the cerebrospinal fluid after the administration of urotropin *—a matter which is of importance not only in all of these transphenoidal operations but in cases of basal fracture or in other conditions in which infection of the meninges is threatened.

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* S. J. Crowe: On the Excretion of Hexamethylenamene in the Cerebrospinal Fluid. The Johns Hopkins Hospital Bulletin, 1909, vol. xx, p. 102.

LIGATION OF THE THYROID VESSELS IN CERTAIN CASES OF HYPERTHYROIDISM.

BY CHARLES H. MAYO, M.D.,

OF ROCHESTER, MINN.

Surgeon to St. Mary's Hospital.

THE surgical treatment of hyperthyroidism has apparently become accepted as a promising procedure for the relief of a most serious condition, notwithstanding the fact that many cases recover spontaneously or are cured by medical treatment.

Much of the fog which surrounded the early-day knowledge of this subject was due to a nomenclature which labeled the syndrome of symptoms with the names of various men who more or less perfectly described the condition. The earlier cases and those presenting irregular symptoms were unfortunate in being denied a classification. They were *pseudo* or *fruste* until they corresponded to those mentioned by Graves or Basedow in description of the disease as a finished product.

That this change from medical to surgical care is based upon rational grounds is evidenced by reports from the laboratories of the surgeons doing the greatest number of operations for goitre—from the clinics of Kocher, Halsted and many others, including our own. These reports not only show the improved condition of the patients operated upon, but they are very uniform in the stated changes occurring in the thyroid in such cases, especially as to the apparent cell activity which seems to be essential to excessive secretion.

The thyroid gland is often small or but little enlarged as compared to simple goitres, and in fact often resembles them. It received less attention from pathologists than the heart or nervous symptoms, and a more careful examination was made of other and associated organs than of the thyroid. As the treatment of the condition was symptomatic it was changed from time to time as new remedies were added to therapeutics.

The early surgical experience in Basedow's disease was unfortunate in the high mortality incident to the delayed surgery, complications and degenerations of essential organs often preventing a cure. Most of the operations were made as a last desperate resort after obvious failures of many forms of medication and other methods of treatment.

While surgery of hyperthyroidism has taken a most prominent position in the treatment of exophthalmic goitre, it has advanced along various lines. (1) By operating upon the gland itself by extirpation of a varying amount. (2) By reduction of its blood supply from vessel ligation—arterial alone, arterial and venous, and venous alone. (3) By operation upon distant organs, especially the pelvic in women. (4) By extirpation of the cervical sympathetic ganglions, and (5) more recently the injection of cytolytic serum has been added.

Greater operative experience upon cases of hyperthyroidism has led to a great reduction in the mortality. This has come about through many changes, *i.e.*, earlier operation, better operative technic, more careful preparation of patients, choosing the operation to suit the case, and the graduated operation.

The anastomosis of circulation in the thyroid is very free. When we consider that this circulation is so extensive in proportion to that of the brain, that the vessels arise from points closely associated with that of the brain, with a blood supply which cannot be destroyed except by deliberate act, and that it has free venous return, had we no knowledge of its function we could still easily understand the importance of the organ.

The earliest ligation of vessels as an operation for the relief of goitre is credited to Wolfler. Our experience with this procedure covers over 200 operations, and with the results obtained by this method we consider that the ligation of certain thyroid arteries and veins, and at times a portion of the gland, seems indicated in some cases of hyperthyroidism.

First, in those suffering from mild symptoms of hyperthyroidism, and those in whom the diagnosis is made early, possibly before the less important eye symptoms or even goitre

is present. In cases which are hardly severe enough to war-
rant a thyroidectomy, the ligation of the vessels will often
produce a cure in a few weeks with but little risk and without
the necessity of special medication.

Second, ligation is indicated in that larger group of acute,
severe exophthalmic goitres, and in the chronic and very sick
patients, who, having exhausted all forms of treatment are
now suffering with various secondary symptoms—dilatation
and degeneration of the heart, fatty liver, soft spleen, diseased
kidneys which have resulted from the chronic toxines as seen
in the later stages of Graves' disease—changes which after all
are the final cause of death. This operation is of particular
value in those cases with a marked pulsation and peculiar thrill
of the superior thyroid arteries.

All severe cases of hyperthyroidism when suffering from
œdema, ascites, dilatation of the heart, diarrhœa, gastric crisis
of vomiting, should be under observation for a short time at
least, and some of them for a considerable period of time to
improve their condition if possible, before even a ligation be
attempted. There is a time in the progress of these cases
when terminal degeneration of essential organs has advanced
so far that they are no longer curable. When surgery is
applied as a last resort it may be possible by using some special
great dexterity and care, to remove part of the gland without
an immediate fatal result. While the disease may be checked,
these patients are seldom sufficiently benefited to warrant the
immoderate risk of an extirpation. On the other hand, at such
times many cases which have at first appeared to be unfavor-
able subjects, will so far improve under symptomatic treat-
ment aided by rest, hygiene, X-ray, etc., as to become suitable
operative subjects at a later period. It is in this class of
cases where ligation as a preliminary procedure is of great
value. The relative safety of ligation as compared with that
of thyroidectomy may lead the operator to accept as surgical
risks patients so far advanced in the disease as to have but
little prospect of cure. In operating upon these cases the
surgeon should use his judgment as to the time and method of

FIG. 1.
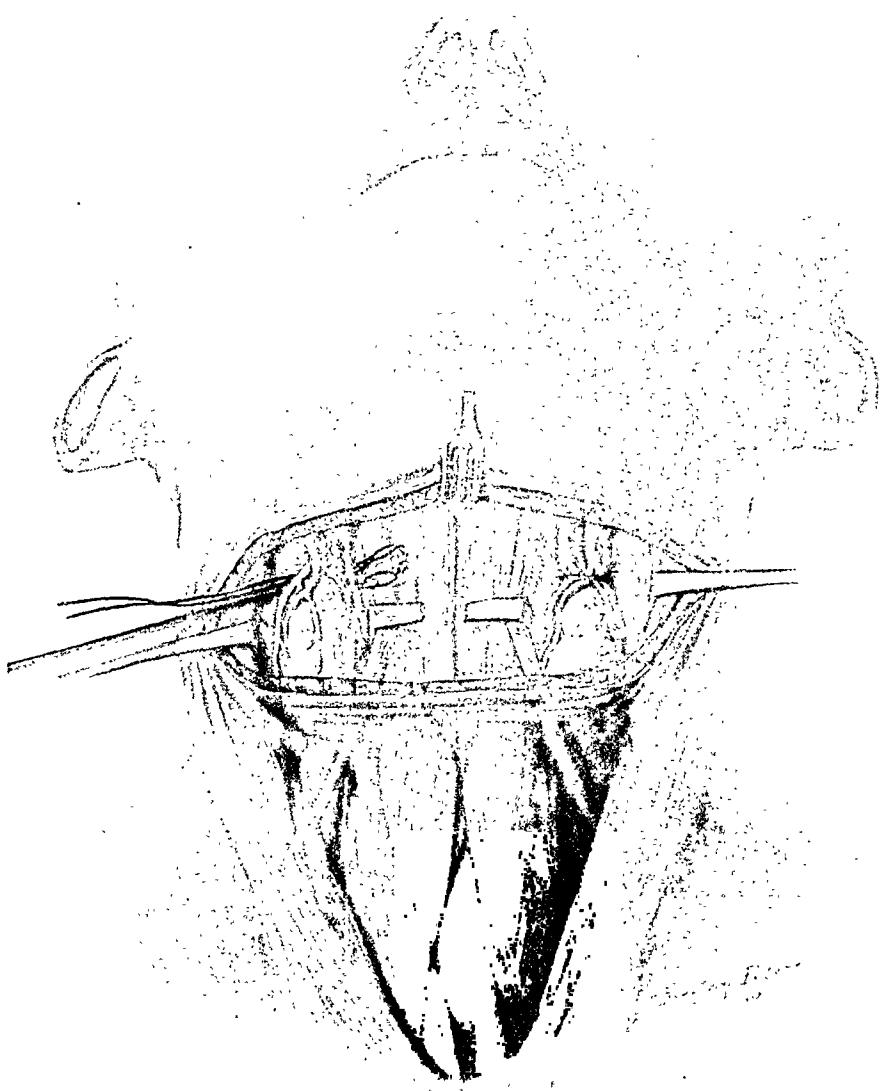
Ligation of the superior thyroid vessels.

operation, and the anæsthetic to be used, from observation. according to the improvement manifest under preparatory treatment.

Anæsthetic.—The choice of an anæsthetic must be left to the individual surgeon, but the immediate surroundings and the ability of the assistants may often modify conditions. Some surgeons like the use of chloroform, others gas and oxygen. We prefer ether on the open mask. Occasionally there are advanced cases in which we use local anæsthesia— one-tenth of one per cent. solution of cocaine in normal salt solution—beneath the skin, to create œdematous tissue. A hypodermic of morphia sulphate gr. $^1/_6$ and atropine solution $^1/_{100}$ is given thirty minutes before general anæsthesia is used. The more restless, nervous and hysterical patients do well with scopolamine morphia $^1/_{200}$ to $^1/_{150}$ one hour preceding the operation with local anæsthesia.

Operation.—A transverse incision gives the best working space as well as the least disfiguring scar. It is made two and a half inches in length, crossing the central part of the thyroid cartilage. The incision should be made in a natural skin crease if possible and should include the platysma myoides, this one incision being better than two lateral. The inner border of the sternomastoid is tracted laterally. This exposes the omohyoid muscle which is tracted up, and in toward the midline. Beneath this muscle is the upper pole of the gland with the superior thyroid artery and vein.

The ligating material is linen passed by an aneurism needle. Should a vein be pierced and a hemorrhage follow the placing of the ligature, it is tracted upon, and a second loop is passed around including more tissue. In most cases this is preferable to a more generous incision with freer dissection. The veins are purposely included to secure venous obstruction, the free anastomosis within the gland capsule making this of advantage. One need not fear the ligation of a nerve in this location, as the inferior or recurrent laryngeal is below. The wound is closed by a subcuticular suture without drainage.

The location of the ligation at the pole of the gland is important, as in one of our cases in which the superior thyroid arteries had been previously ligated at a point where they were given off from their origin at the external carotid, there was but partial and temporary relief. At the second operation we found a reversal of the circulation in the large inner branch anastomosing with the inferior thyroid, and in the upper part of the gland the circulation was but little reduced.

The after-care of these patients is according to the severity of their symptoms. Rest in bed, slow saline by rectum often repeated. Patients will usually absorb several quarts of the solution within twenty-four hours, but should they be subject to diarrhœa the rectal saline may not be possible. In such cases, if from the severity of the symptoms it is especially desirable to use salines, they are given subcutaneously.

Most of the patients are in a serious condition when operated upon, and a few develop very alarming symptoms. For these scopolamine can be given in doses varying from $1/_{200}$ to $1/_{150}$ to control the great muscular restlessness, and injections of strophanthin and digitalis may be used with caution. Adrenalin will slow the pulse but should be used with care at this time because of the strain upon the heart muscle. Camphorated oil 10 to 15 minims hypodermically is a useful stimulant. An ice-bag over the pericardial region is of benefit. The danger after operation continues for several days in the more severe cases.

Not only is the body charged with excessive secretion but as the gland contains at the time of ligation much secretion for absorption, therefore the general progress of these cases toward recovery is not so rapid as where a definite quantity of the gland tissue can be removed.

In the large hard glands of hyperthyroidism where some reversion has occurred with colloid deposit, ligation is not indicated.

The changes in the gland after ligation are most interesting. There is a change from the great increase in cell development back to a condition of simple goitre. This is

produced by a simple exfoliation of cells and does not resemble the degenerative changes which are found in the glands removed in the late stages of Basedow's, or those in which serum treatment has been used.   In both of these there is a true cytolysis or chemical destruction of the cell.

Five hundred and eighty patients suffering from hyperthyroidism or exophthalmic goitre have been operated upon at St. Mary's Hospital.   Of these 225 were ligations of the superior thyroid arteries and veins.   A number of these ligations have been made too recently to base observations upon except as to the immediate risk of operation, which is about 2 per cent. in deaths occurring within a few days.   Ten of these cases were operated upon too late and did not improve, but continued in their downward progress, dying in from eight to ten months later of their disease.   In these deaths is included a case of pernicious anæmia.

We now have full records of 138 cases which were ligated sufficiently long ago to make their report of value.

There were 12 cases of ligation of the remaining superior thyroid artery and vein following thyroidectomy of the larger lobe and isthmus, the primary operation being followed by relapse after one or several years with growth of the remaining lobe.

Twenty-eight cases of thyroidectomy followed the ligation of both superior thyroid vessels.   Although all of them were very severe cases at the time of ligation, there was no mortality from the second operation.

In cases of ligation without thyroidectomy the results were as follows:

	Cases.
Slight improvement	9
Great improvement	44
Very marked improvement	11
Absolutely well	4
Cases of questionable exophthalmic goitre, no improvement	9

Of this latter type there are two classes: (1) Some peculiar cases of myocardial trouble, and (2) those in which the

35

nervous symptoms predominate. Both classes are associated with other symptoms of hyperthyroidism. It is possible that in some of these the symptoms come from changes in other ductless glands, especially the suprarenal; as yet they remain to be better described.

While many patients reported indefinite gain in weight, there were 68 cases in which an accurate report was given, showing that 62 patients gained an average of 20½ pounds from three to five months after operation. If cases were excluded that were about normal weight at the time of operation the average gain would exceed this. Six patients lost an average of 6 pounds. Most of these were but little reduced at the time of operation.

In the majority of cases the ligation is made as a definite step in a graduated operation to reduce excessive secretion of the gland, and some of the reported cases are yet to be operated upon for the removal of part of the gland as a secondary procedure. Some of the patients in this series consider themselves too well at present to undergo another operation, and will probably do so only under the stress of a relapse of their symptoms, when it may be advisable to ligate the right inferior thyroid artery as a second step toward thyroidectomy. We found this procedure of value in nine cases. On several occasions, because of the various seemingly urgent reasons involving the safety of the patient, we deemed it advisable to convert a thyroidectomy into a ligation of vessels.

THE SIGNIFICANCE OF THYROIDISM AND ITS RELATION TO GOITRE.*

BY JOHN ROGERS, M.D.,

OF NEW YORK,

Surgeon to the Gouverneur and St. Francis Hospitals.

In April, 1905, the first patient suffering from Graves' disease was treated with the specific antithyroid serum prepared by Dr. S. P. Beebe in the laboratory of the Cornell Medical College. During the course of the following year it became apparent that this antiserum was not beneficial for all cases, and other organic products, to be referred to later, were introduced, and in the comparison of the results obtained by the use of these different substances and by the ligation of one or more of the thyroid vessels or extirpation of a greater or less amount of the gland much valuable information has been obtained. Four hundred and eighty cases representing all stages and varieties of thyroidal disease have thus come under my personal observation for a greater or less length of time, and Dr. Beebe has records of about as many more who have been treated with his laboratory products by many other physicians. In my series approximately 15 per cent. have been cured of all traces of their disease; some 10 per cent. have no abnormal subjective symptoms but still retain signs generally of goitre—less often of exophthalmos or other indication of their disorder noticeable to the trained observer; about 50 per cent. have been improved to a greater or less extent, which usually means that after a month or two of treatment, with alleviation of symptoms, the patients have passed from observation and may at present be better or worse than when last seen; about 17 per cent. have failed to show any improvement and 8 per cent. have died from the natural progress of their disorder, in which class there must be included two cases

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occurring early in my experience, one of which perished within eighteen hours after operative removal of one lobe and the isthmus of the thyroid and the other within seventy-two hours from an acute exacerbation of the pre-existing thyroidism apparently caused by the injection of antithyroid serum at too frequent intervals. These statistics emphasize the gravity of the prognosis of what is commonly believed to be a benign affliction and are the more sinister in that so-called thyroidal disease seems to be becoming more prevalent, at least in the hospital wards in this city. In this whole series there have been observed only three cases of malignant disease of the thyroid, and these were inoperable when first seen.

In the attempt to elucidate the manifestations of pathological physiology there are to be considered, first, the natural history of the diseased process; then the effects upon it of more or less specific therapeutic interference, or measures which more or less obviously affect the organ or organs known or supposed to be at fault; and, lastly, from the data thus derived there remains the proof of the theory of the diseased process by its reproduction experimentally in animals, an achievement which has not as yet been accomplished,—but if the hypothesis which can be constructed chiefly from clinical data is correct, the experimental evidence should be obtainable.

Typical exophthalmic goitre usually begins insidiously and may pass through the stage which is generally conceded to be dependent upon an excess of thyroid secretion, to terminate in myxœdema or a condition dependent upon an insufficient amount of secretion. As the symptoms which are produced by well recognized disease of the thyroid gland vary so greatly in different cases, it is advisable to trace the whole process clinically from beginning to end.

Incipient Stages of What May be Later Exophthalmic Goitre.—At the outset there is almost always a history of more or less prolonged mental and physical strain. There is an insufficient amount of sleep and rest and an excess of worry and cerebral excitement combined at the same time with marked physical effort. Common examples are a wife

caring for a sick husband or a mother for her child in a pro-
longed illness.   Often it is a young girl who at a period of
maximum growth and development is forced to study early
and late or to take a wage-earning position under trying cir-
cumstances; or there is a history of one or more surgical
operations or some severe infectious disease before the onset
of the disturbance.   The first symptoms noted are those of
simple over-fatigue and perhaps of anæmia, although the
hæmoglobin may be only slightly below the normal percentage.
There is delay and difficulty in getting to sleep, or a consid-
erable insomnia; the appetite falls off and there is some con-
stipation; the cerebration is over-active but not capable of sus-
tained effort, and an irritability of temperament or melancholic
ideas which are not inconsistent with the usual surroundings,
may appear.   About this time considerable muscular weakness
is evident and is naturally ascribed to the insufficient sleep or
to the unusual strain under which the patient is passing; but
throughout the disease this muscular weakness, sometimes
described expressively as extreme "fatiguability" is very char-
acteristic and often belies the general appearance of good
nutrition.   With this there is some dyspnœa on exertion; but
a more evident sign is the "thumping," over-acting heart,
which is most likely to be felt at night on going to bed.
Tachycardia is usually intermittent at first and occurs after
any slight exertion, and so is often overlooked or ascribed to
the wrong cause.   Later it becomes more frequent and is felt
without appreciable reason, though some emotion combined
with indigestion may be apparent on close inquiry or observa-
tion.   Constipation and intestinal fermentation with coincident
palpitation or "throbbing" heart and some insomnia, are such
common complaints that they may be thought unworthy of
notice, but they differ only in degree from the similar and
more serious manifestations which are evident later when the
disease has become fully established.   Only in that later period
· the intestinal disturbance has more often the form of frequent,
partly formed or loose stools, or of diarrhœa; but throughout
the whole progress of events there appears to be a somewhat

vague and yet distinct connection between the emotions or central nervous system, the heart, or vasomotor apparatus, the digestive tract,—and in this the liver must be extremely important, and the muscles. The participation of the thyroid gland in the disturbance at this stage can only be inferred by the marked if not always beneficial results consequent upon the administration of thyroid substance and by the unmistakable symptoms which will appear later if the disease is allowed to take its usual course.

The incipient period of greater or less nervous and physical exhaustion, with its insomnia, loss of appetite, indigestion and fermentation, constipation, occasional or constant rapid heart action and subjective sensation of heart " thumping " and the mental excitability or nervousness, may terminate under common sense and hygienic treatment in complete or partial recovery, or after weeks or months under less favorable circumstances, in typical exophthalmic goitre.

That the disease does not always seem to begin as above indicated, need not be contradictory of the general principle that it starts as a disorder of nutrition: it sometimes, for instance, is first noted after a severe infection like typhoid fever or tropical malaria. Rarely it seems to arise suddenly and from traumatism or extreme emotion, as after a runaway or automobile accident or after the receipt of distressing news.

Under the first of these conditions the explanation necessary for establishing the unity of apparently dissimilar causes must lie in the fact that the mechanism of resistance to bacterial infection undoubtedly taxes nutrition to the utmost, and the only wonder is that exophthalmic goitre is not a more frequent sequence, for the seeming participation of the thyroid in the defensive process will be indicated later.

A sudden origin of fully developed Graves' disease, however, is not so readily accountable, and involves a belief that it must have existed in a latent or unrecognized form for some time previous to the plainly evident manifestations, or that the thyroid must have possessed some inborn or acquired weakness to permit the perpetuation of symptoms which may

occur normally as a transient phenomenon attendant upon extreme nervous and physical fatigue; the sudden appearance of typical symptoms and their speedy subsidence is evidently possible. The indefinite continuation which constitutes the phenomena of Graves' disease must, however, presuppose a preliminary masked stage or a previously weakened or inherently poor thyroid acting for some time to its fullest capacity and then suddenly over-taxed. Why some manifestly incipient cases, like the "overtrained" athlete or overworked school girl, should recover under simple hygienic measures, while others, in spite of this care, progress to the typical chronic disorder and perish directly or indirectly from it, remains to be considered. The most obvious explanation lies in the degree of severity to which the incipient stages have advanced and the inborn vitality or character of the organ which appears chiefly at fault.

That. the disease may apparently develop suddenly is nevertheless conceded; but an attempt has been made in the above to show that this suddenness of onset is more apparent than real, and when other explanations fail to provide for this variation from the usual slow onset attended or caused by disorder or deficiency of nutrition, an inborn weakness of the thyroid must be seriously considered to account for its pathological physiology.

The Symptoms of Exophthalmic Goitre in the Early Stages.—The prominent symptoms of exophthalmos, goitre, and tachycardia, especially the first two enumerated—from which the expressive designation of the disease is derived, vary so much in different cases and even in the same case at different periods, and are so little characteristic of the most dangerous type of the disorder, that the term thyroidism is suggested and will be employed here as being much more comprehensive and less liable to induce error in diagnosis. For in all the various manifestations of this process the thyroid gland seems to be the key to the situation; and unless the effects of thyroid feeding may be so considered, no one sign is pathognomonic of the thyroidal participation. Therefore,

exophthalmos and goitre at least must not be understood as at all necessary to establish the diagnosis of thyroidism, and reliance must be placed upon less noticeable symptoms. Among these a certain degree of intermittent or constant tachycardia and general vasomotor irritability with sudden cutaneous flushing under the slightest excitement are very constant, as is also the subjective sensation of heart " thumping " at such times. The peculiar muscular weakness which often belies the appearance of good health, is also very noticeable in all forms of thyroid disorder. Quick, jerky movements of the extremities, a sign which may be dependent upon the muscular weakness as well as upon the nervous excitability, and the fine tremor in the stiffly extended fingers, are quite noticeable.

In these early stages the susceptibility of the patient to heat and the tendency to perspiration is in striking contrast to the dry skin, cracking nails and dread of cold, which are some of the most constant signs of a beginning insufficiency of the thyroid or myxœdema. Insomnia, morning headache, an appetite out of proportion to the evident illness and a thirst for water which increases with the intensification of the diseased process, generally precede and accompany the exophthalmos and the goitre. When the disorder is of the severe type there is always a temperature of 99° to 100° F., and as it becomes more intense the temperature rises. The character and color of the stools is also significant, not of thyroidal disease, but of the organs which become involved in the progress of the disturbance. For with exacerbations or with intensification of the typical Graves' symptoms the movements from the bowels become light-colored and diarrhœic. The blood seldom shows more than slight anæmia, but there is almost always a lymphocytosis which is somewhat proportional to the severity of the symptoms, and the urine regularly contains an amount of kreatin which varies in the same way and increases with the severity of the thyroidism in this period.

The early or mild symptoms of exophthalmic goitre may continue for months or years and spontaneously or during or

after pregnancy, or, under some form of treatment, gradually disappear until complete recovery has occurred. But recovery never takes place suddenly or even rapidly. Restoration to the normal condition always, like the beginning of the pathological process, requires a considerable period of time. Rarely the early stages pass within a few days into the toxæmic stage with high temperature, quick, labored respiration and rapid pulse with irregular, tumultuous action of the heart. There is a dry tongue, nausea, vomiting and diarrhœa and often extravasations of blood in various parts of the body. The whole picture is one of a violent septicæmia or septic intoxication with vasomotor, nervous and gastro-intestinal symptoms predominating, and—as Dr. W. G. Thompson has pointed out—is not unlike that of malignant endocarditis, for which it is frequently mistaken, particularly .if neither exophthalmos nor goitre are perceptible. In their absence the diagnosis must generally be made on the history and by careful exclusion; but in the toxæmic stage it is evident that the liver is involved along with the gastro-intestinal tract, for this organ is usually enlarged and sometimes reaches two or three finger breadths below the ribs and is tender and painful and there may be perihepatitis. These patients also complain bitterly of pain referred to the epigastrium. It may or may not have to do with the liver, but seems to be in direct proportion to its enlargement and tenderness. If death occurs it will be preceded by a rising temperature, vomiting, diarrhœa, headache, and delirium and stupor. Rarely there may be a gradual subsidence of the symptoms and, as after the mild early stages, the patient will pass into the chronic form of the disease.

Chronic Exophthalmic Goitre, or Chronic Thyroidism.— In this stage the exophthalmos and goitre are more constant and pronounced than in the early stages; but even if one or the other or both should be absent the diagnosis ought to be evident from the vasomotor and nervous irritability and the muscular weakness. In this period, however, there gradually appear some lesser symptoms which sharply contrast with those in the earlier stages. The skin instead of being con-

stantly moist becomes more and more dry and perspiration, if present at all, is only noted after exertion or excitement. There is less complaint about heat and more about cold. The constant thirst so marked at the outset decreases and the appetite is not so good. A marked pallor often showing a brownish or yellowish tinge succeeds the usual flushed appearance of the early period of the disease. Some œdema of the eyes may occur, or puffy swellings which come and go in the skin and subcutaneous tissue about the eyelids and face, or in the supraclavicular region, or in the fingers, and stiffness of the hands is felt; there is also a tendency to nosebleed, and subcutaneous ecchymoses are produced by the slightest traumatism. The tachycardia gradually lessens but may be pronounced at times, especially after any slight gastro-intestinal disturbance or fatigue, or .at the menstrual period, or without appreciable cause. Some tension appears in the radial pulse and may become marked. The tremor and nervous irritability become less and less noticeable but are usually apparent during emotion or fatigue and absent in periods of quiet.

The exophthalmos is so extremely variable, and it is so often absent even in cases which are severe and otherwise typical, that one is almost forced to believe exophthalmos to have an origin from some other organ or group of organs and to be only indirectly connected with the thyroid. The goitre in the chronic period instead of being soft and smooth in outline becomes more and more dense, nodular and hard, and generally shrinks in size. The temperature is constantly below and not a trifle above the normal point. The blood examination shows only a simple anæmia, which may be considerable; but there is no excess of lymphocytes or small mononuclear leucocytes, and the urine is generally normal and contains no excess of kreatinine, but there may be occasionally some albumin. The psychoses which sometimes appear in patients showing the symptoms of Graves' disease, occur in this later chronic stage and suggest a disordered nutrition of the nervous system rather than an intoxication. The mental disturbance is somewhat peculiar and not readily

classifiable, and while there may be pronounced delusions they are not consecutive and persistent. The mentality is rather wandering or vague and of erratic purpose. Also, these psychoses are more common in asthenic weakly or poorly nourished individuals, and if improvement in general nutrition can be produced they may subside or disappear.

. During the late chronic period, with approaching myxœdema the weight may improve but the strength persistently remains poor or deteriorates, and at any time severe or fatal exacerbations of toxæmic thyroidism may occur, and are apparently often brought about by unusual nervous and physical strains. Gastro-intestinal disturbance, with light or clay-colored stools and constipation, later followed by diarrhœa, seems, however, a more frequent cause or accompaniment of the severe exacerbations in this stage than in the early periods of the disease. The toxæmia shows the same nervous and vasomotor irritability as in the earlier periods, but the fever is much less and the advance towards the fatal termination is slower and apt to be attended by œdema of the legs or ascites or general anasarca. A few of these patients may even improve at this stage and then suddenly drop dead in syncope, especially if the goitre has become inelastic, hard and nodular. Sooner or later—the time seems dependent upon the severity of the process—there always develops some enlargement of the liver. At first this organ will perceptibly vary in outline from day to day or from week to week with exacerbations and remissions of the general condition. The increase in the size of the liver occurs at first quite rapidly, and with this there is pain so that one is forced to believe in a localized and very marked congestion. Then if there is a subsidence in the tachycardia, nervousness, and gastro-enteric disturbance, the lower border of the liver may approach the costal margin by one or two finger breadths in as many days, with relief of the pain; but this hypertrophy is almost sure to recur. It marks, I think, the beginning of the end, as after it has once appeared I have never known such a case to recover, though life may be prolonged some weeks or even months.

This enlargement is generally regarded as caused by conges-
tion dependent upon blood stasis and cardiac failure. But it
often occurs without manifest insufficiency of the heart, and
hence is probably due to reasons other than circulatory. It
is enough, however, to note here that the liver sooner or later
becomes involved in the diseased process.

Myxœdema Stage.—If the patient survives the dangers of
the chronic stage of exophthalmic goitre, the nervous and
vasomotor irritability and exophthalmos become gradually
less and less noticeable until they disappear. The goitre,
however, may persist or rarely enlarge, but the muscular
weakness slowly increases until the head may drop forward
and rest with the chin on the sternum and complete helpless-
ness supervenes. The peculiar pallor of the skin, often with a
slight flush over the malar bones, the puffiness about the eyelids
and lips, the dense œdema—especially in the lower extremities,
the mental torpor and the slow pulse and the anæmia, all
constitute a picture too well known to require repetition. But
the myxœdema following Graves' disease usually leaves some
traces of the original disorder and only occasionally is of the
classical type of congenital or unknown origin and of slow
development. Some sign of exophthalmos may persist or the
slow pulse may show brief periods of rapidity, and there is
very commonly more or less indigestion—generally of the
fermentative type. Occasionally there may be attacks which
look very much like a gall-stone colic, with nausea or vomiting
and light or clay-colored stools, and I have known at least
one of these cases to have undergone exploratory laparotomy
with entirely negative results.

The prognosis of the myxœdema, or myxœdematoid con-
dition, following thyroidism or exophthalmic goitre, is also,
I think, more unfavorable and less amenable to treatment than
is the variety of spontaneous or unknown origin. Some of
these cases suffer much from lipomata in various parts of the
body, and indeed there is much which is suggestive of, if not
identical with, the disease called adiposis dolorosa. In gen-
eral it may be said in conclusion that all cases of exophthalmic

goitre which do not recover spontaneously or under treatment, during the early typical or early chronic stages, or which do not perish in these periods from exacerbation of thyroidism, finally die with an atypical myxœdema.

This brief review of the natural history of the disease suggests an apparent origin in over-strain and coincident or consequent malnutrition, and that the thyroidism which follows may have some elements of a protective or compensatory mechanism which has become perverted and harmful. Also that its tendency is towards indefinite continuation, and in a manner the disease seems self perpetuating.

The not infrequent exacerbations of the process are apparently brought about by over-strain or by incidental infections, like tonsillitis, and are accompanied by more or less marked digestive disturbances, as is the case in the beginning.

SIMPLE GOITRE.

Simple goitre or hypertrophy of the thyroid gland is usually considered to be a disorder which is entirely distinct from Graves' disease and to represent a totally different pathological process; but there are many reasons for doubting this conclusion and for suggesting something of the same pathological physiology at least in the origin of both exophthalmic and simple goitre. In the first place the family histories of these cases show a very distinct prevalence of both conditions. The predisposition to goitre, like tuberculosis, is very often traceable through several generations, or it appears in several members of a family, and though distinct Graves' disease may occur only occasionally and as an exception in these individuals, goitre without any apparent systemic disturbance may be a family peculiarity. This, if it indicates anything, only suggests an organ of congenital weakness. The hypertrophy is at first soft and symmetrical and is most often noted at about the period of puberty and at the menopause, and is much more common in women than in men and in subjects who are not robust though they may appear stout and well nourished. The " nervous " element, as in the exoph-

thalmic form of the enlargement, is generally quite noticeable, and individuals with goitre are usually very susceptible to favorable or unfavorable surroundings. Given the causes which apparently produce exophthalmic goitre—namely, a combination of nervous and physical strain—and these patients with simple symmetrical goitre are very prone to suffer with more or less typical thyroidism, which may subside or continue indefinitely. The unfavorable hygienic circumstances which accompany the development of simple goitre and the period of life are also the same as those which precede Graves' disease or the exacerbations of the process.

There is another group of cases in which the goitre seems to be of the same character and to arise in the same way but later, under favorable conditions, instead of entirely disappearing, does so only in part, and more or less of the gland remains enlarged and gives the physical signs of a circumscribed, tense, elastic cyst. Then, under emotion, excitement or physical strains, this will temporarily swell, and coincidentally there will be more or less marked signs of thyroidism, with tachycardia, dyspnœa, insomnia, general " nervousness " and weakness, but usually no exophthalmos unless the unfavorable conditions persist too long. Not infrequently the dyspnœa is attended by a feeling of constriction of the throat and stridulous breathing, which indicates actual compression of the trachea. Under rest and good hygiene all the symptoms except the circumscribed enlargement of the thyroid generally disappear, but are easily again excited, and in course of time other areas of the gland may become involved, and the signs of thyroidism—instead of being intermittent— become continuous, and are generally mild though showing occasionally severe exacerbations, and are then accompanied by exophthalmos.

These cases in which part of the gland appears normal and part to have undergone adenomatous or cystic degeneration behave like a " leaking retention cyst " in which the supposedly retained secretion is toxic and only escapes into the circulation under unusual conditions which are apparently

connected with emotion, fatigue, gastro-enteric disturbances or bacterial infections or traumatism. It is generally believed, if not actually proved, that normally the escape of the thyroid secretion is through the lymphatics, and in the above cases the whole picture suggests a primary diffuse hypertrophy with at least more than the usual functional activity. In this process there may occur a localized obstruction of the lymphatics with retention of the colloid and degeneration of the epithelium. Under favorable conditions the remainder of the gland, which may never by the way have been noticeably enlarged, returns to the natural size and state, but the damaged portion remains, and whenever the organ is called upon, as it seems to be automatically, to increase its activity during nervous and physical strains of all kinds, the resulting congestion induces a leakage into normal or abnormal lymphatic channels or directly into the blood, and thus causes the symptoms of thyroidism which are intermittent in that they cease at least in the early stages of the disturbance, if the apparently exciting factors can be relieved. It is out of place to introduce the pathology and treatment of this condition here, but it is necessary to do so for the sake of clearness, in order to point out the apparent significance of this form of goitre and its relation to others.

If the patients who present a localized, circumscribed tumor of the thyroid with intermittent thyroidism, are given the antithyroid serum the symptoms will generally be relieved for the time being, but the tumor will not appreciably change, and marked general prostration will follow. Extirpation of the diseased area, however, will cure the whole disturbance except the muscular weakness, which will persist indefinitely unless some form of thyroid feeding is pursued or unless the normal remaining residue of gland hypertrophies. These two circumstances—namely, the apparent necessity of thyroid feeding to shorten the convalescence or to establish it, and the seeming prevention of recurrence or of goitrous hypertrophy of the rest of the organ by thyroid feeding, are very suggestive of an original over-activity of the thyroid which is compensatory to some nutritional failure. It is probably

nutritional because of the seeming great variety of exciting causes, in all of which a common denominator can more readily be found in an error of nutrition rather than in any other one disturbance.

Another very important matter to note is the histological structure of these diseased areas or " leaking retention cysts." The tumor may show the ordinary multiple cystic degeneration, but in some part or parts, often at the periphery, there will be found the changes which are characteristic of the abnormal thyroid of typical Graves' disease. These changes are not found in the simple goitres which are unaccompanied by systemic disturbance.

The hypertrophy of an organ for some failure or deficiency in its own or another's function is too familiar to need discussion, and the histories and progress of the cases of the exophthalmic and the more common simple goitres described above all suggest an enlargement compensatory to some general requirement which seems connected with nutrition. It is probable, however, that some goitres may represent a compensation of a slightly different but still closely allied character, as it seems connected with the metabolism or body chemistry of the element iodine. There is no evidence that any other element enters into the problem, although there are popular prejudices which connect the prevalence of goitre in certain localities with the presence of calcium in such regions.

Long before iodothyrine was isolated as a supposed active constituent of the thyroid, iodine in one form or another was found to affect patients with thyroidal disorders. Some goitres under its administration will disappear,—less often they enlarge. In cases of thyroidism, however, it is usual to find that eventually all the symptoms are made worse and the enlargement of the thyroid greater, although at first iodine may seem beneficial. The clinical experience—namely, that the administration of iodine may cause an already hypertrophied thyroid to still further enlarge—alone is strong evidence that an excess of this element in the water or food may be an important factor in the production of goitre; also it is conceivable that a deficiency in the ingested iodine might lead to a hypertrophy of a conversely compensatory nature. The

common kind of goitre, however, at least in the region of New York, seems to arise as a more generalized form of disturbance, and in the history and symptomatology indicates an attempt at compensation for what appears to be a failure in complex nutritional processes. What these may be remains to be studied.

PATHOLOGICAL ANATOMY.

The lesions associated with and complicating thyroidism have been found to involve almost every other organ in the body, and include a persistent or enlarged thymus gland and hypertrophy of the pituitary, and have been analyzed many times without throwing light on the mechanism of the primary disturbance. The changes in the thyroid itself, however, require some mention. It is still a matter of dispute as to whether or not there are constant histological and chemical changes in the thyroids of patients who suffer from the symptoms of Graves' disease. The alveoli of the gland in the fully developed and active stages of the disorder show chiefly infolding and reduplication or multiplication of the epithelial wall and basement membrane, which may go on to such an extent as to entirely fill some or all of the alveoli to the exclusion of the usual colloid. More or less of this condition seems always to be present in cases which give the usual signs of thyroidism, and the intensity of the symptoms coincides with the increase of the epithelium. The colloid material also stains less intensely than that in the normal gland. The chemical analysis of the iodine content of the gland has in the past shown great variations, but some recent determinations by Riggs and Beebe,[1] and Riggs,[2] show that error in the analytical processes explains the discrepancies. By the latest analysis by Riggs and Beebe [1] the amount of iodine to the gramme of gland seems generally to decrease in direct proportion to the severity of the symptoms of thyroidism, and this in conjunction with the well known susceptibility of these patients to the ingestion of iodine (and they are generally injured by it) is very suggestive. It is possible, therefore,

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[1] Personal communication.
[2] Jour. Am. Chem. Soc., vol. xxxi, No. 6, June, 1909.

that the ultimate causation of exophthalmic goitre lies in some
vital or biochemical defect of the thyroidal epithelium which
concerns the ability of the gland properly to take up and utilize
iodine. This does not explain the evident connection of the
thyroid with other organs nor the mechanism of the disturb-
ance and how it may be remedied; but considered in connection
with the cases described above, of " leaking retention cysts "
of the thyroid, in which part of the gland is normal, and the
cases of typical exophthalmic goitre which can be cured by
removal of half the thyroid, there is a strong hint that both
the quality and the quantity of the secretion are important in
the constitutional disturbance. There are many cases of goitre
in which one lobe of the thyroid appears normal while the
other lobe is three times larger and the patient, while quies-
cent, shows no signs of thyroidism. But if excitement or
fatigue are introduced the enlarged portion of the gland evi-
dently swells, and coincidentally there occur tachycardia,
dyspnœa, " nervousness," and weakness which may gradually
subside when repose is enforced. Removal of the enlarged
and degenerated lobe stops these attacks. Examination of the
excised tissue shows that the mass of secreting epithelium and
colloid is of course greater than normal; but in my experience
there is always present, as mentioned before, some of the
structure characteristic of Graves' disease, and the laboratory
has regularly reported a percentage of iodine below that of
the average healthy gland.

In thyroidism, therefore, an increased quantity of secre-
tion is evidently present, and with this there is some evidence
that a gradual or rapid deterioration in the quality of the
thyroid secretion may play a very important part in the con-
tinuation and progress of the pathological process.

REMEDIES WHICH HAVE BEEN FOUND EFFECTUAL IN RELIEV-
ING OR MODIFYING SYMPTOMS.

Good hygienic conditions and, above all, mental and phys-
ical quiet are so evidently necessary in the treatment of all
the symptoms associated with goitre that the importance of

fatigue—especially nervous fatigue, which is an unsatisfactorily vague term—is strongly emphasized in the etiology of the disturbance connected with hypertrophy of the thyroid.

Of the remedies which may be called specific, in that they are designed to affect some one organ supposed to be at fault, the element iodine has already been mentioned. Some cases of simple goitre and a few of thyroidism may be made to improve or even recover entirely with this substance alone; but more frequently, after an apparent initial improvement there will follow an equally apparent injurious effect which will be accompanied by enlargement and hardening of the gland and generally gastro-enteric disturbances.

THE SPECIFIC ANTITHYROID SERUM AND THE THYROID PROTEIDS OR ACTIVE CONSTITUENTS OF THE GLAND.

The preparation of this substance and the reasons for believing the antithyroid serum a specific for inhibiting the functional activity of the thyroid gland without directly affecting any other organs, are described in an article on this subject in the *Archives of Internal Medicine* for November, 1909, by Dr. Beebe and myself.

The pure proteids of the gland are made somewhat as follows: The hashed-up fresh gland is extracted in normal salt solution for a week, then strained through gauze and the filtrate treated with dilute acetic acid which is supposed to precipitate the thyroid nucleoproteid material. The supernatant liquid is then poured or filtered off and half saturated with ammonium sulphate, resulting in a precipitate of the thyroid globulin which is approximately the colloid or fully formed normal thyroid secretion. The acetic acid or nucleoproteid precipitate and the ammonium sulphate or globulin precipitate can be dried and given by mouth or redissolved in an aseptic condition suitable for hypodermatic administration. The antithyroid serum is made by injecting rabbits or sheep with these combined proteids at intervals of five to seven days for several weeks. The blood of the animal thus " immunized " to the thyroid proteids is then drawn from the carotid

and the serum separated and tested for its potency. It is then put up in sealed glass tubes each containing from one-half a cubic centimetre to 2 c.c., according to the potency or activity of the serum.

Dr. Beebe, my co-laborer in this field, has prepared all these substances, and I have had nothing directly to do with the chemical and biological problems involved. He informs me that neither the acetic acid nor the ammonium sulphate precipitate is entirely free from the thyroid globulin or thyroid nucleoproteid; in other words, the " pureness " of these pro-teids is only relative, and while the nucleoproteid or globulin predominates in their respective precipitates, neither precipi-tate is without some admixture with the other. Furthermore, Dr. Beebe is uncertain as to the chemical and physiological properties of these proteids, except that the nucleoproteid may contain a little more iodine than the thyroid globulin. The chemical properties may be closely allied, but I believe the physiological difference between these proteids is considerable and very important and more far reaching in its bearing upon disease in general and especially upon the so-called autointoxi-cations than the profession and the physiologists appreciate.

Certain observations upon the histological changes in the thyroid glands of Graves' disease are suggestive of the physio-logical difference between the nucleoproteid and the globulin or colloid matter. The more acute and intense are the symp-toms of Graves' disease the more epithelial cells and nuclei and the less colloid do the alveoli of the patient's thyroid show. In other words, the increase in the elements which yield the nucleoproteid material seem to bear a direct proportion to the severity of the tachycardia and general toxæmia. More-over, these glands which show an active proliferation of the epithelium and a great deal of disintegrated cell material and very little colloid, supply a large nucleoproteid precipitate with acetic acid and very little globulin or ammonium sulphate precipitate. The gland from a normal individual exhibits the opposite characteristics and yields a much greater ammonium sulphate than acetic acid precipitate. These differences

between the normal organ and one obtained from a patient who has died from the toxæmia of exophthalmic goitre invite a belief that the alveoli which are filled with disintegrating and incompletely formed cells and their nuclei, excite symptoms differing from those produced by alveoli in which the cells are fewer and the colloid much more abundant. Some of the difference probably depends upon abnormality in the cells, as in a case of myxœdematoid type the administration of the nucleoproteid material from a pathological gland will immediately excite the characteristic Graves' disease symptoms, especially the tachycardia; but the same symptoms can be brought out in such a case by a slightly larger dose of the nucleoproteid obtained from a normal gland. With this introduction the apparent differences in the physiological action of the thyroid nucleoproteid and the thyroid globulin are indicated below. These substances were administered to patients suffering not only with thyroid disease but also with a great variety of other pathological conditions, and much valuable information was thus obtained. Incidentally it is well known that throughout medical literature there are scattered undoubtedly honest reports of benefit from thyroidal feeding in a great variety of pathological conditions, and one of the most recent and remarkable of these reports is upon the result of such treatment in certain skin disorders by Johnston and Schwarz in the " Transactions of the International Congress of Dermatologists " of 1907.

The proteids obtained from sheep thyroids were first employed hypodermically, and their initial effects were quite constant; but in the course of days or weeks the dosage had to be greatly increased in order to accelerate the pulse or to raise the specific gravity of the urine, which were the gross changes looked for in patients not supposed to have any thyroid derangement. Those who might have a myxœdema taint in their symptoms were extremely susceptible to these proteids, but gradually lost this susceptibility; in other words, the dosage had to be increased to maintain the benefit sometimes apparent. But in continuing and increasing the dose, a few

of these (cancer, myxœdema, and epileptic) cases showed very peculiar nervous and psychical symptoms—such as ataxia, disturbances of sensation, and transient mild delusions or even slight delirium.

In discussing these unpleasant experiences with Dr. Beebe he suggested that sheep thyroid, being a foreign proteid, when injected into man might gradually produce an antibody or an immunity, and hence in its continued use (the length of time varying in different persons) the foreign proteid might become useless or even harmful. When given by mouth these foreign proteids, however, seem to excite no immunity, and theoretically they should not. Hence in the subcutaneous administration of the " pure " thyroid proteids, after the above experiences we have always used those obtained from the normal human gland. Those which are fresh and obtained from subjects free from disease are alone employed, and this generally means a fairly young individual who has suffered death by violence, generally a murder or suicide. The acetic acid precipitate or the nucleoproteid portion of such a gland is scanty; the ammonium sulphate precipitate or thyroid globulin or colloid is fortunately more abundant. Dr. Beebe has prepared the nucleoproteid and thyroglobulin precipitates in a 1 : 1000 solution for hypodermatic use,—and bearing in mind that neither solution is entirely free from the other, noteworthy physiologic differences can be detected in their effect upon the heart and nervous system, especially in an individual who has passed through the active stages of Graves' disease and while still retaining some of the tachycardia and nervous irritability, shows the dry peculiarly colored skin of myxœdema with its puffy face, irregular digestion, supraclavicular fatty pads and weakness. A person without manifest thyroid disease, like an inoperable cancer subject or an epileptic, is not nearly as susceptible to these proteids; but when the dosage is raised and pushed, differences like those in the thyroidal cases are apparent.

As elements to be mentioned below may confuse the understanding of the apparent physiologic action of these two sub-

stances, their effects on the presumably normal subjects only will be described. In these a five (5) minim injection of the nucleoproteid solution once in four hours will elevate the pulse rate and induce insomnia and a feeling of nervousness within one or two days. A similar dose of the thyroglobulin solution gives an entirely negative result. The concentration of the thyroglobulin furnished me by Dr. Beebe can be increased to 1 : 100, and in this strength a five (5) minim dose at four hour intervals may in some normal individuals produce tachycardia and nervousness; but usually not. In cases of ulcerated carcinoma with inflammation and pain the nucleoproteid solution does not relieve the pain and inflammation and does cause tachycardia, breathlessess, weakness, and nervousness. On the other hand, ten times this strength of the normal human thyroid globulin, or a 1 : 100 solution can be given constantly and for weeks to a patient—for example, with an ulcerated carcinoma of the pharynx accompanied by bacterial infection of the neck—and there will be no ill effects upon the heart or nervous system and there will be noticeable relief of the infection. This experiment can be repeated upon surgical patients with wounds open to infection, such as those about the mouth, bladder, prostate or rectum, and while the rule has exceptions, the thyroid globulin solution appears to promote healing and prevent infection without the least ill effect. The thyroid nucleoproteid solution appears to have little or none of this beneficial effect upon the mechanism of resistance, and does cause unpleasant cardiac and nervous disturbances which are so closely analogous to the symptoms in Graves' disease as to almost force the conclusion that they are due to the same cause—namely, an excess of thyroid nucleoproteid in the circulation.

It is not out of place to note incidentally some of the conditions in which these substances have seemed beneficial, especially as they suggest the physiology of the thyroid gland for which an hypothesis is to be offered. In addition to its apparent use in increasing the powers of resistance the thyroid globulin solution also seems to have some beneficial effect upon

the prolonged vomiting, fermentation and constipation which occasionally follows ether anæsthesia. The nucleoproteid solution seems in this condition useless or harmful. In one case of vomiting of pregnancy which threatened suppression of urine and eclampsia, the 1 : 100 thyroid globulin solution in forty-minim doses every four to six hours was given for weeks with most striking benefit upon all the symptoms and no ill effect whatever. It was suggested in this patient because she had recovered from Graves' disease under antiserum treatment months previous to the pregnancy. The 1 : 1000 nucleoproteid solution, on the other hand, was tried at the outset and stopped because of its tendency to excite tachycardia, weakness and nervousness.[3] Enough, however, has been said in the above to show the apparent difference in the effect upon presumably normal individuals between the thyroid nucleoproteid and the thyroid globulin solutions and also the extraordinary number of conditions as indicated by clinical symptoms, which seem to be influenced favorably by the thyroid globulin. These same differences in effect, though to a less marked degree, are noticeable when the thyroid nucleoproteid and thyroid globulin are given in dried form by mouth. In this form of administration the products obtained from sheep and pig glands have been mostly used. The thyroid nucleoproteid, therefore, in whatever way it is administered, seems limited in its effect first to increasing the rapidity of the heart action, then that of respiration, and if pushed further it induces a subjective feeling of weakness and nervousness. In all this there is a strong presumption that the nucleoproteid of the thyroid has a direct stimulant influence upon the sympathetic system in general and upon the cardio-accelerator nerve in particular. The thyroid globulin apparently does not participate in this. When given by mouth, however, in an unprotected form, it must be remembered that all organic bodies which partake of the nature of a " hormone " (Starling's designation of any substance or secretion serving as a

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[3] E. G. Ward, in Transactions of the American Gynecological Association, 1909.

chemical activant for some other secretion or organ), may be destroyed and rendered inert by the stomach digestion. To this rule the thyroid nucleoproteid seems to be a rather remarkable exception, for its effects are marked and constant, no matter how it is introduced into the system. The thyroid globulin, when swallowed in solution or dried form, appears entirely or almost entirely, inert, and what little effect results can be ascribed to the traces of the thyroid nucleoproteid which cannot as yet be entirely excluded from the preparation. To obviate the difficulty these and the other organic substances to be mentioned below, have been administered by rectum in cocoa butter suppositories, or by mouth after being encased in capsules which are then coated with melted salol and afterwards with a solution of keratine. Capsules thus covered must be encased in another capsule to prevent loss of the protecting cover by chipping or abrasion. The average dose of the thyroid nucleoproteid given by either of these methods is about one-fiftieth of a grain, but the effects of its administration in this way presents a noticeable difference from that produced by the subcutaneous use of the human thyroglobulin. The latter in excessive dosage up to thirty (30) or forty (40) minims of a $1:100$ solution given hypodermatically every four hours to individuals without manifest or acknowledged thyroid disease, will produce some tachycardia, insomnia, and a subjective feeling of nervousness. This has always caused a cessation of the subcutaneous administration of the thyroglobulin, and it has not been pushed further; but the rectal use of the substance has not given such warnings, and in several instances the dosage has been increased up to one-tenth or one-fourth grain once or twice daily. This almost invariably will result first in producing light-, then clay-colored stools, then constipation and headache, and if continued, pain, referred to the right hypochondrium, will follow, and this is generally accompanied by fever which may reach $103°$ or $104°$ F., and the liver will noticeably enlarge and may be felt a finger's breadth below the free border of the ribs. These symptoms are much more readily excited in cases which show

traces of or irregular signs of thyroidism than in those who do not. As stated above, the subcutaneous administration of thyroglobulin does not produce these unpleasant and alarming symptoms or else the other symptoms of tachycardia and nervousness prevent a cautious investigator from going far enough to obtain them.

The suggestion of the effect upon the liver of this very active constituent of the thyroid and the method by which it was obtained opens up a wide field of supposition and experimentation with the other ductless glands, and Dr. Beebe has supplied me with the nucleoproteid material of the pancreas, adrenal and liver which have been prepared in the same way as the thyroid nucleoproteid. 1 : 1000 solutions of the nucleoproteids of these organs for hypodermatic administration have also been employed, but to a much more limited extent. The ammonium sulphate or globulin precipitates have not been tried, as they were very scanty in amount and of doubtful effect. The nucleoproteid material from the liver, however, when given by mouth seemed entirely inert; when given hypodermatically it is decidedly laxative in carcinoma and epileptic cases, but no other influence on the organism could be detected. The liver globulin in the same class of cases seemed to produce a feeling of fulness in the head, some somnolence and a tendency to nose bleed, but there was no change in the blood pressure. As the nucleoproteid and globulins of the liver appeared to exert no influence over the symptoms in thyroidism they will not be referred to again. The nucleoproteids of the pancreas and adrenals, however, seem to be of great value.

The adrenal nucleoproteid differs from adrenalin in that it lowers instead of raises the blood pressure. When given to patients with Graves' disease who show a blood pressure of 130 to 150 or 160, the adrenal nucleoproteid will reduce this pressure within a few hours to 110 or lower. Ten minims of the 1 : 1000 solution administered hypodermatically every three or four hours shows the same efficiency as one-eighth grain of the dried product given by rectum or by mouth in

protected capsules. .It also has little or no vaso-constrictor effect. It is sometimes remarkably beneficial for the somewhat irregular forms of thyroidism with high tension pulse and for those who show more or less marked pigmentation of the skin. In the latter cases the best effects are usually obtained by a combination of the adrenal with the pancreas nucleoproteid. The commercial desiccated suprarenal powder generally increases the symptoms of thyroidism and in some instances, when given by rectum, seems to be a violent purgative. In overdose the adrenal nucleoproteid may increase the " nervousness " and produce diarrhœa.

The pancreas nucleoproteid has been employed chiefly in the dried form and given by rectum or by mouth in protected capsules, and in cases which show no signs of thyroidism it seems to produce even in comparatively large dosage, no effect other than very mild catharsis and headache. It has seemed beneficial for the glycosuria in some cases of surgical diabetic gangrene, especially when the solution of the human nucleoproteid is given hypodermatically. In thyroidism, however, the pancreas nucleoproteid generally appears to be a pronounced sedative and hypnotic; but there are as yet some unexplainable differences between this and the commercial products known as trypsin, holadin, pancreatin and pancreatic extract. When administered by rectum some one of these substances, generally the nucleoproteid or trypsin, will prove beneficial in allaying the nervous irritability, thumping heart and insomnia, while any of the others may seem to aggravate these symptoms.

CASE HISTORIES ILLUSTRATING THE RESULTS OF " SPECIFIC " REMEDIES IN DISEASED STATES ACCOMPANIED BY HYPERTROPHY OF THE THYROID.

To facilitate the understanding of the therapeutics these cases will be summarized and then repeated in more detail.

CASE 335.—Mrs. D. presented what has been described as a " leaking retention cyst " of the thyroid with intermittent symptoms of Graves' disease. Excision of the tumor cured all the

symptoms except the weakness, which disappeared under subsequent prothyroid treatment or thyroid feeding.

CASE 1.—Miss F. presented typical exophthalmic goitre in the early stages which slowly but entirely disappeared after three injections of the antithyroid serum. A recurrence of the incipient symptoms four years later was cured by pancreas feeding.

CASE 82.—Mrs. L. presented typical exophthalmic goitre in the chronic stage and was at first greatly improved and then made worse by the antiserum. Thyroid feeding or prothyroid treatment then became noticeably beneficial.

CASE 126.—Mrs. P. presented typical exophthalmic goitre in the chronic stage. The symptoms were made much worse by the antiserum and by feeding the combined thyroid proteids and by iodine. A change to the human thyroid globulin given subcutaneously produced an immediate improvement and a complete cure after several months of treatment.

CASE 114.—Mr. McG. presented atypical exophthalmic goitre in the late or myxœdematoid stage. Nothing relieved the symptoms except the administration of the human thyroid nucleoproteid subcutaneously.

CASE 287.—Miss R. presented typical exophthalmic goitre in the chronic stage. No medication produced improvement. After ligation of the vessels there was an immediate improvement and a gradual return to a nearly normal condition. Later the administration of pancreas nucleoproteid by rectum seemed a valuable adjuvant in the convalescence. All other preparations of pancreas excite signs of thyroidism.

CASE 210.—Miss C. presented typical exophthalmic goitre in the early stage. The antiserum produced some improvement. Excision of the more enlarged lobe and isthmus of the thyroid resulted in an apparently perfect cure at the end of one month.

CASE 23.—Miss M. presented typical exophthalmic goitre with a general condition indistinguishable from the last case, and underwent (at the hands of another surgeon) an almost complete thyroidectomy. Death followed within twenty-four hours, apparently from an acute exacerbation of the pre-existing thyroidism. In the exacerbation the usual dose of antithyroid serum was given without the least effect.

CASE 43.—Mr. C. presented typical exophthalmic goitre in the late chronic stage. The antithyroid serum and the thyroid

proteids aggravated all the symptoms. The administration of iodine alone resulted in immediate relief and a complete cure within three months.

CASE 120.— Mrs. G. presented typical exophthalmic goitre in the late chronic stage, with marked pigmentation of the skin and a blood pressure of 150 mm. Hg. The administration of the solution of human adrenal nuceloproteid subcutaneously relieved all symptoms and reduced the blood pressure from 150 to 110 mm. within thirty-six hours. Later the combination of the adrenal and pancreas nucleoproteids seemed more beneficial than the adrenal alone.

CASE 315.—Miss B. presented unmistakable incipient exophthalmic goitre. Five grains of trypsin given by rectum reduced the pulse rate from 90 to 60 in one night. Later the combined thyroid proteids seemed more beneficial in the convalescence.

CASE 151.—Mr. P. presented typical exophthalmic goitre in the chronic stage, with glycosuria. Excision of one lobe and the isthmus of the thyroid has cured all symptoms.

CASE 192.—Dr. G. had had typical exophthalmic goitre and recovered completely with the exception of exophthalmos. Then severe diabetes appeared. The administration of the thyroid proteids was followed by an immediate increase of the glycosuria. Death occurred six months later from diabetes.

CASE 43.—Miss B. recovered completely from typical exophthalmic goitre under the administration of the antiserum. Three years later she developed severe diabetes. A combination of strict diet with the administration of large doses of pancreas nucleoproteid by rectum and complete rest resulted in a disappearance of all symptoms. The resumption of work brought a recurrence of glycosuria; diabetic coma and death followed.

Glycosuria or diabetes has appeared in five cases in this series, and the only one which has survived for six months is Case 151, in whom two-thirds of the thyroid were excised.

These histories illustrate what are apparently different phases of the same general process and show how the pathological condition can be relieved or cured by different remedies which are specified in each instance in that that remedy alone is required.

(To be continued.)

TREATMENT OF DRY ARTHRITIS WITH INJECTION OF VASELINE.

BY THORKILD ROVSING, M.D.,

OF COPENHAGEN, DENMARK,

Professor of Clinical Surgery to the University in Copenhagen.

In the *Hospitalstidende*, No. lii, 1904, I related two cases of dry traumatic arthritis in the hip joint, where in 1902 I succeeded by the injection of sterilized yellow vaseline in completely restoring the function and in fully making to disappear the violent pain and intolerable creaking when walking. This satisfactory result has in both cases continued after the expiration of seven and nearly five and a half years respectively.

Regarding the extension and practicability which this simple treatment can be expected to get in the future, I expressed the sure expectation that the injection of vaseline would be of importance in the treatment of malum coxæ et genu senile, because the suffering, from an anatomical and pathogenetic view point, is often very like the dry traumatic arthritis in younger individuals, in whom I had obtained such good results.

On the other hand, I expressed myself reservedly concerning the use one could expect of injection of vaseline in the many other kinds of chronic arthritis which manifest themselves by pain and creaking and stiffness of the articulations—the uratic and rheumatic arthrites, arthritis deformans, the alterations remaining after acute infectious arthritis (the gonorrhœal in particular). This reservation was mostly due to the knowledge that Büdinger [1] had tried the method in such cases with very inferior result. At the same time I saw in the very small quantity of vaseline which Büdinger had injected in these cases a possible explanation of the bad results, and was of the opinion that it was still worth trying the method in selected cases of this kind, only with larger quantities of vaseline.

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[1] Konrad Büdinger: Die Behandlung chron-Arthroit und Vaselin-injetition. Wien. klin. Wochenschrift, 1904, No. xvii.

Since this first report I have treated 51 joints with the injection of vaseline, but I consider it right, as a basis for the conclusions which I am going to now state, to use only the cases treated up to January, 1908, the result of which I have been able to control at least 18 months. The number of these cases is 30, with 35 vaseline injections owing to 5 of the patients having had bilateral joint affection. I have divided these cases into two main groups, of which the first, consisting of 7 cases, comprises the *non-traumatic " dry " arthrites,* whether they are of rheumatic, uratic or unknown origin; while the last group comprises the *traumatic dry arthrites,* into which comes malum coxæ senile, together with 4 cases where vaseline has been injected in order to prevent ankylosis after arthrotomy and arthrectomy—23 cases in all.

GROUP I.—ARTHRITIS URICA AND ARTHRITIS DEFORMANS.

Synopsis of Cases.

CASE I.—Emma N., aged 59, farmer's wife. Admitted December 27, 1904; discharged, July 2, 1905.

History.—Seven years ago the patient, who had up to that time been well and borne four children, began to suffer from rheumatism in finger, shoulder, and knee joints. Some of the finger joints became deformed. When moving, grinding was felt in the shoulder and knee joint which was very painful.

Operation, January 21, 1905. Puncture of both knee joints. Out of each joint 5 to 6 c.cm. of turbid, yellow synovia was evacuated, in which numerous, whitish yellow fluff was found. Injection into each joint of 25 c.cm. vaselini flavi.

Course.—Temperature, January 22, 39.6 C. to 37.5 C.; January 23, 38.7 C. to 36.6 C. Temperature after that normal. For the first few days pain was severe in the right knee. February 5, the vaseline seems to have acted favorably in the left knee, which can now be moved without creaking. Pain, though somewhat decreased, is still felt in the right knee.

Result: medium.

CASE II.—P. A., spinster, aged 48. Admitted September 8, 1905; discharged, October 30, 1905.

History.—Delicate in her young days. No uratic symptoms. Her present illness began 15 to 16 years ago, when a sudden swelling of the right wrist developed. No temperature. Shortly afterwards one finger joint after the other was attacked. By degrees both wrist and elbow joints, shoulder and knee joints and lately the left hip joint became affected. Gout-like attacks of the first metatarsophalangeal joints occurred. The knees especially inconvenience her.

Objective Examination.—Right shoulder ankylotic, left shoulder allows a little movement with grinding. Elbow joints are inflected, deformed. Wrist and finger joints also. Knee joints slightly inflected. The movements very limited. Creaking, pain, and swelling heavy. Effaced contours.

Operation.—October 2, 1905. In ether narcosis. Puncture of both knee joints; no synovia found in either joint. Injection into each joint of 15 c.cm. vaselini flavi.

Course.—No rise in temperature. Some improvement in the mobility of the left knee. The right knee is, on the other hand, almost as painful as before the operation, but there is no grinding or creaking.

Result: slight amelioration.

CASE III.—Miss L., aged 52. Admitted October 1, 1905; discharged November 14, 1905. Private clinic.

History.—Quite well until the menopause set in at the age of 45. Then she began to suffer from rheumatism first in the feet then in the knees, especially after the patient four years ago had a feverous illness with pains in the right side of the abdomen and shortly after pneumonia. Arthritic changes in finger, elbow, and shoulder joints have developed rapidly. Asthmatic and a little cyanotic.

Objective Examination.—Systolic murmur. Left knee is kept slightly flexed, even little movements hurt badly. The right knee on the contrary can be moved without any pain and to about normal extent.

Operation.—October 3, 1905.—Local anæsthesia. Puncture of the left knee joint, from which 25 c.cm. of turbid, fluffy fluid is evacuated. Injection of 20 c.cm. vaselini flavi.

Course.—Only slight rise in temperature, 39.8 C., in the evening, but severe pain felt after the injection. The movements are so painful that it is considered advisable to apply an im-

mobilizing bandage. The patient died later on in her home of an affection of the heart.

Result: bad.

CASE IV.—B. S., spinster, aged 36, schoolmistress. Admitted December 28, 1905; discharged February 25, 1906. Private clinic.

History.—Has suffered from bronchitis several times; the expectorate has been examined well for T. B. with negative result. Twelve months ago pains and a slight swelling of the right knee began. For this reason patient was kept in bed. Since then the creaking and pains when moving the knee have increased. She stands about and walks a good deal.

Objective Examination.—No accumulation in the joint. Extended soft creaking by movements.

Operation.—Ether narcosis, February 10, 1906. Puncture of the right knee from which no synovia can be pressed out. Injection of 20 c.cm. vaselini flavi.

Course.—Temperature December 30, 38.5 C. to 37.8 C. Heavy pains, swelling and strain of the joint occurred during the first three weeks and there was a slight rise in temperature; 38.1 C. to 37.4 C. in the evenings for a whole month. Treatment with epithema tepid, passive movements, and massage to finish up with. About three months after the walk was good and free from pain.

Result: good.

Remark.—The diagnosis doubtful (traumatic? uratic? tubercular?).

CASE V.—A. M., aged 49, hospital nurse. Admitted February 7, 1906; discharged February 28, 1906. Private clinic.

History.—Patient suffered from rheumatic fever at the age of 14, this lasted a week. For the last 5 or 6 years she has suffered pains in both hip joints, the left one in particular. The pains lessen at changes in the weather, and hurt badly when patient gets up to walk after sitting or lying down. Strong creaking is heard in the joints when the pains are felt.

Operation.—February 10, 1906, ether narcosis. Puncture of the capsule which has been uncovered by an incision. No synovial fluid. Injection of 20 c.cm. vaseline.

Course.—February 1, temperature 38 C. to 37.4 C. Otherwise no rise in temperature; no pains, but the treatment has caused no improvement in this case.

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Result: nil.

CASE VI.—H. P. N., aged 58, laborer. Admitted May 1, 1906; discharged August 2, 1906.

History.—Arthritis genus dext. and ankylosis; arthritis genus sin. sicca. Patient has suffered pains during the last five years in the right knee. He has kept it in splints for the last two years, and during this time full ankylosis has set in. In the last six months pains have commenced in the left knee. Strong creaking is noticed by movements which, by the by, can be done to rather a normal extent.

Operation.—May 9, 1906, resectio genu dext. Bony ankylosis between cond. int. fem. et tibiæ. No fluid, the cartilage gray, the remaining articular surface bluish red. Puncture of the left knee. No synovia. Injection of 15 Grammes vaselini flavi.

Course.—Bad pains and great swelling of the left knee. The temperature rose steadily until 39.5 C. On May 16 another puncture was performed, by which a good quantity of serous fluid, mixed with blood, and a little vaseline was removed. No microbes (microscopical examination and culture). May 23: Temperature normal. Discharged on August 2 and was then able to walk fairly well with a crutch or stick. Very little pain was felt in the left knee, which he moved freely.

Result: good.

CASE VII.—Miss A. L., aged 31. Admitted March 20, 1907; discharged April 17, 1907.

History.—Patient has since her twenty-first year suffered from multiple joint affections which began with pains in the left elbow joint, followed by increasing restriction of the movability; after that the finger joints were attacked and both ankle joints in the same way. Four years ago pains began in both knees. The symptoms vary a good deal. Sometimes patient is quite unable to walk. Fever never stated. Hip and shoulder joints free.

Objective Examination.—The left elbow ankylosed in rectangular position. The finger joints show typical arthritis deformans. The right knee joint slightly inflected, can only be moved very little and with great creaking. Patella unshiftable; left patella a little shiftable. Otherwise proportions the same. Röntgen photo shows the articulation surfaces in both joints rough, with pointed tips.

Operation.—March 23.   Puncture of both knees.   From the right knee a good deal of turbid, bloody, serous fluid is evacuated; from the left one nothing.   Injection of 15 c.cm. vaseline into each knee joint.

Course.—Temperature March 24, 38.4 C. to 37.3 C.; March 25, 38.4 C. to 38.1 C.; March 27, 38.5 C. to 38 C.   Severe tension of the left knee, why puncture is performed once more, and a good deal of vaseline and fluid comes out.   Temperature after that normal.   April 17, patient discharged.   The walk very bad, hardly any better than before the operation.

Result: bad.

If we now, first of all, examine this group of cases—seven in number—whose history of illness is presented briefly in Group I, we can at once see by the results recorded, how mediocre or bad the injections of vaseline have acted in the majority of cases: Cases I, II, III, V, and VII.   In some cases there appear besides severe pain, great swelling and expansion of the joint capsule, also symptoms of fever; in short, signs of an acute state of inflammation which vanishes in the course of few days or a week.

If the patient then gets up and begins to walk about, his condition is as a rule quite as it was before the operation; in some cases the patient is slightly better, but in others the walk has become even more painful than before.

The reason of this circumstance soon became evident to me by observation and inspection of the joint during the operation.   It appeared as it was, that even in the most creaking joints of this category there were by no means dryness and lack of synovia; on the contrary, an ample fluid existed, though never clear, more or less turbid, grayish, containing fluff and threads, microscopically numerous leucocytes; but in no case did I succeed in proving microbes.

In other words, the question in all these cases is about exudative processes of inflammation in the joint capsule, whether these are due to chemical irritation (uric acid, toxins) or yet unknown and not demonstrable microbes, and it is easily understood that the vaseline under these circumstances only

acts as a foreign body, which further irritates the synovial membrane and leads to increased exudation. In any case, when *turbid fluid* flows out by the puncture, I do *not* advise the injection of vaseline.

Considerably more difficult is the question how to act in the minority of cases, where such arthritis seem finished with a creaking, painful joint, which is *deficient in synovia*. First, there is this difficulty,—that the differential diagnosis of the traumatic joint affection may be hard to make, if pronounced symptoms of inflammation have not appeared at an earlier stage of the disease, as in Cases IV and VI, where no synovia was found in the joint. As a rule the course after the injection of vaseline, exactly like the latter case, will give the diagnosis by a more or less severe return of the inflammation with high temperature, painful, strained swelling of the joint capsule, sometimes peri-articular œdema. But it is indeed too late, and an unfortunate way of finding the diagnosis, if the injection of vaseline was absolutely unnecessary or even injurious in such cases. I am not disinclined, however, to believe that the injection of vaseline in several cases of this sort is worth trying or experimenting with.

With two of these patients, the above mentioned Case IV, a school mistress, 36 years of age, and Case VI, a laborer, 58 years of age, I obtained in the end, after the tedious reaction had ceased, a really good functional result—almost normal mobility without creaking, and a strong leg, fit for use.

With another patient, Case V, where the disease formerly had had the appearance of a slight, rheumatic polyarthritis, but the puncture gave no fluid in the joint, the injection of vaseline seemed quite without any effect; but the reaction after the injection on the other hand was extremely slight, as the highest temperature was 38° C., and the pains not more considerable than they used to be every day.

The result of my experiments with the injection of vaseline in the case of really chronic apparently dry arthritis of uratic, rheumatic or other infectious origin has been as follows: *If by the puncture fluid is found in the joint, one ought to abstain*

from the vaseline treatment completely; if, however, the joint is found completely dry and the inflammation apparently extinct, one ought to attempt the injection of a smaller quantity of vaseline, which cannot distend or strain the capsule, afterwards carefully watching any possible return of the symptoms of inflammation.

GROUP II.—MALUM SENILE AND OTHER FORMS OF DRY TRAUMATIC ARTHRITIS.

Synopsis of Cases.

CASE I (Published in the *Hospitalstidende*, 1904, No. lii).—Miss K., shop girl, aged 32. Admitted April 14, 1902; discharged April 29, 1902. Readmitted June 3, 1902; discharged June 16, 1902.

History.—Congenital left-sided hip luxation. Caput femoris displaced high up in fossa iliaca externa, expanding the gluteal muscles. For the last three to four years constant increased creaking and grinding in the joints when moving. You can hear it a long way off. August 6, 1900, operation. The capsule is opened by longitudinal incision. No synovia. Caput femoris greatly deformed; covered with pikes like a thornapple. The pike-covered calotte was removed with rounded kerf. Healing per primam. Temporary improvement, but at the end of the year the attacks were as bad as ever.

Operation.—April 14, 1902. Ten c.cm. of vaseline is injected without incision. April 22, soundless and painless walk lasted four weeks, then creaking and pains began once more. I thought that too small quantity of vaseline had been injected. June 6, 1902, the incision was made to the capsule and now under control of the eye, twenty-five c.cm. of vaseline flavi were injected into the joint cavity.

Result.—The result was excellent and has remained unchanged up to the present date (July 15, 1909), more than seven years,

CASE II.—(Published in the *Hospitalstidende*, 1904, No. lii.) I. (farmer), aged 25. Admitted March 21, 1904; discharged April 4, 1904.

History.—At the age of 16 right-sided coxitis healed up with

ankylosis, after which his walk was lame but free from pain so that he was able to look after his farm, until 12 months ago, then pains and creaking began in his left hip; these have increased so that he is now quite unable to work. The right lower extremity 3½ cm. shorter than the left one. By passive movements strong osseous creaking is noticed in the left hip joint.

Operation.—March 24, 1904. Puncture of the left hip joint. No synovia. Injection of 20 c.cm. of vaseline.

Course.—No rise in temperature. March 28, 1904: He gets up and is able to walk without any pains or creaking. Patient has been capable of doing his work during the past five years.

Result: excellent.

CASE III.—N. C. L. (sailor), aged 22. Admitted December 8, 1904; discharged January 4, 1905.

History.—At the age of nine severe trauma of the right regio glutæalis caused by being upset out of a cart. After some time an abscess was formed and some bits of bone were discharged. The fistula closed quickly. Since then free motion but increased creaking in the right hip joint. Two months ago patient fell on board ship in bad weather and hurt his right hip badly. Since then heavy increased pains and creaking after movements, especially in the evening.

Objective Examination.—Healthy appearance, considerable atrophy of the muscles in the right gluteal region and on the right femur. By rotation and abduction heavy creaking (osseous) in the joint, but the movements are otherwise normal. No shortening of the extremity.

Operation.—December 22, 1904. An incision 5 c.cm. long is made above trochanter major, the capsule is exposed and punctured with a big trocar. No synovia is found. Direct from the tube 25 c.cm. of fresh sterilized vaseline is injected. The wound is joined with aluminium bronze covered with collodion and cotton wool.

Course.—December 29, 1904. The suture is removed. Healing without reaction. Patient gets up. January 4, 1905: Has been free from pains and creaking since the operation. Is up all day and feels absolutely well. Discharged.

Result: excellent.

Remark.—Information in October, 1906. Shortly after the

discharge the patient enlisted at the board of conscription for the navy as a sailor and took part in all the hard training on board, till one day, when the surgeon heard that he had lately undergone an operation in his hip, he was sent to Professor Rovsing to inquire if he ought to be excused from service. This was advised. Since then patient has been perfectly strong and well.

CASE IV.—S. L., married woman, aged 33. Admitted December 27, 1904; discharged January 16, 1905. Readmitted January 30, 1905; discharged February 5, 1905.

History.—No tubercular or other morbid disposition. Quite well until three years ago—when by a fall patient hurt her right knee. Since then she has felt pains and creaking every day, not much swelling. Patient has been kept in bed from time to time, but treatment with immobilization, tinct. iodi. spirit., cantharides, water cure has been in vain.

Objective Examination.—Strong, healthy appearance. No swelling of the right knee which measures exactly the same as the left one (35 and 32 cm.). No accumulation in the joint. She can move the knee to a full extent, but distant rather soft creaking and grinding is heard.

Operation.—December 29, 1904, ether narcosis. Puncture of the right knee joint. No fluid flows out. By strong compression a few drops of *clear* synovia is pressed out at last. Injection of 30 c.cm. yellow, sterile vaseline. Collodion and cotton wool dressing. Microscopy and culture from the drops of synovia show no microbes, no leucocytes. January 31, 1905: Second operation. Puncture, whereby 20 c.cm. of vaseline and a little thin synovia is removed.

Course.—The evening after the operation temperature was 38.2 C., and normal after that. After the injection the creaking vanished completely. January 5: Patient gets up and walks by the aid of a stick. Tension and pains in the knee when moving. Discharged. January 15: Comes back again. The right knee swollen, 3 cm. bigger than the left one. Bursa subcrurea is particularly strained, fluctuating. No creaking. The knee can be extended fully, with good function, but only flexed till about 80° without pains. January 31, 1905: As it is certain that too much vaseline has been injected 20 c.cm. is removed. After that patient is completely free from pains. Discharged February 5, 1905.

Result: finally good.

Remark.—Injection of too much vaseline.

CASE V.—V. H., a merchant's wife, aged 37. Admitted March 28, 1905; discharged April 22, 1905.

History.—By a fall 22 years ago patient hurt her left hip; felt pains for some months, but these passed away until 10 years ago when she noticed increasing weakness and stiffness of the left hip joint. Treatment with massage, electricity, douche, but all without any effect. Patient has used a stick during the last 12 months.

Objective Examination.—Movement free until about 60°, then she began to complain. Slight creaking is felt. She is very stout. Atrophy of 2 cm., but no shortening of the left lower extremity.

Operation.—After ineffective treatment with iodide of potassium and local steam baths, puncture was performed on April 18, 1905, without evacuation of synovia; and after that injection of 20 c.cm. vaselini flavi.

Steady improvement.

Result: medium.

CASE VI.—P. H. (blacksmith), aged 24. Admitted April 11, 1905; discharged April 18, 1905. Private clinic.

History.—Three years ago patient dislocated his right shoulder while working hard in the field during harvest time. After a while pains and creaking developed. These were at their worst in the evening and improved by taking exercise. For six weeks treatment with immobilization without any effect. Heavy creaking in the right shoulder, some also in the left shoulder.

Operation.—April 14, 1907. Local cocain-anæsthesia. Puncture of the right shoulder joint, by the cannula being introduced exactly below acromion. No synovia flows out. Injection of 20 c.cm. of sterilized vaselini flavi.

Course.—April 18. No creaking, no pains, even when moving a great deal. Patient has been well ever since.

Result: good.

CASE VII.—H. N. (farmer), aged 55. Admitted July 3, 1905; discharged July 17, 1905. Private clinic.

History.—Quite well until five or six years ago, when he began to feel pains in both knees; especially while standing. Pains have increased gradually since then and during the last

three or four years strong creaking has begun in his left knee joint especially. Now he is quite unable to work. No swelling in the knee regions. Strong creaking in both joints. The right one can only be flexed to a right angle. On the right side a corpus liberum is supposed to exist. Patient does not wish arthrotomy.

Operation.—July 6, 1905. Puncture of both knee joints, by which no synovia can be removed. Injection into each joint of 15 c.cm. vaselini flavi. July 7: No creaking—no pains. July 10: *Temperature normal, patient gets up. July 17: Able to walk quite well without pains. Discharged.*

Course.—No reaction.

Result: satisfactory.

Diagnosis: Malum senile.

CASE VIII.—A. J. (farmer), aged 76. Admitted July 26, 1905; discharged August 7, 1905. Private clinic.

History.—Ten years ago symptoms of malum senile began in both hip joints and both knee joints. These symptoms have increased gradually and during the last six months patient has had to walk with a stick or a crutch. Movability decreased, bad pains, but only inferior creaking in the hip and knee joints. The knees worry patient the most, consequently he wishes for treatment of these only.

Operation.—July 28, 1905. Puncture of both knee joints. No synovia can be pressed out. Injection of 15 c.cm. sterilized vaseline into each knee.

Course.—The evening of the operation temperature rose to 38.5 C.; after that it was normal. August 2: No pains, no creaking by passive movements. Patient gets up. August 4: His walk much improved without any pains in the knees. August 7: Patient thinks walking much easier, and is delighted with result.

Result: good.

CASE IX.—A. K. (spinster), aged 70. Admitted September 8, 1905; discharged October 2, 1905.

History.—Patient well until two or three years ago when she began to feel bad pains in the right hip-joint when moving. These pains have increased gradually since then. She is only able to walk with a stick and bends forwards very much.

Objective Examination.—Great atrophy of the right femur,

which differs 5 cm. from the left. Movements very painful, producing bad creaking. Position adducted and inflected.

Operation.—September 15, 1905. Primary ether narcosis. Puncture of the right hip joint through the capsule exposed by incision. Not one drop of synovia flows out. One feels the articulating surfaces creaking against each other. Injection of 20 cm. of vaseline.

Course.—No rise in temperature. No pains after the injection. September 21: Patient gets up. September 24: Patient walks about without any pains. October 2: No pains, no creaking while walking.

Result: excellent.

Case X.—Miss H., aged 30. Admitted October 7, 1905; discharged November 15, 1905.

History.—Kyphoscoliosis since the age of four, with shortness of breath, palpitation of the heart, etc. For the last ten years pains in the left jaw joint when moving it. Also increasing creaking and grinding which greatly inconveniences the patient.

Objective Examination.—Creaking and pains when moving the left jaw joint. No swelling. The Röntgen photo shows nothing abnormal.

Operation.—October 18. Local cocain anæsthesia. Incision to the capsule. Puncture of the lowest articulation chamber of the left joint. No synovia found. Injection of 1–2 cm. vaseline. October 30: Injection of vaseline in the uppermost articulation chamber.

Course.—Creaking even after the operation. Pains the first few days, after that the pains and creaking decrease considerably. Patient discharged, greatly improved.

Result: medium.

Case XI.—S. S. (married), blacksmith, aged 62. Admitted November 24, 1905; discharged December 14, 1905.

History.—Patient quite well until six years ago when he began to suffer pains in both shoulder joints and over arms. Two month ago he fell and hurt the right shoulder joint, whereby the movability was further restricted and the pains increased.

Objective Examination.—No swelling or deformity in the shoulder regions. Bad pains and creaking by movements. Röntgen photo shows the surface of cavitas glenoidalis somewhat rough.

Operation.—December 5, 1905. Ether narcosis. Puncture of both shoulder joints below the hindmost corner of acromion. No synovia is found in either joint. Injection of vaseline: 15 cm. in the left, 20 cm. in the right shoulder joint.

Course—December 6: Temperature 38° C. to 37.3° C. Pains in both shoulder joints. After that no fever, no pains. December 8: Patient gets up. December 9: Movements free. No creaking. December 12: Patient can swing his arms without any pains.

Result: excellent.

Case XII.—K. M. C. (married), aged —, farmer's wife. Admitted November 5, 1905; discharged December 6, 1905.

History.—Increasing pains in the right hip during the last four years. Patient has alternately been kept in bed and walked about with crutches. She was emaciated greatly.

Objective Examination.—The movements of the hip cause great pain, and pelvis moves then too. Two cm. atrophy of the right femur. The Röntgen photo shows no destruction. Inferior creaking.

Operation.—November 18. Ether narcosis. Incision. Puncture. No Synovia. Injection of 20–25 c.cm. of vaseline. Suture.

Course.—Excellent effect. November 23: No pains felt in the hip when moving it; it acts freely. December 1: Walk painless and natural.

Result: excellent.

Case XIII.—P. P. (farmer), aged 34. Admitted January 8, 1906; discharged February 12, 1906. Readmitted January 26, 1907; discharged February 16, 1907.

History.—Patient has congenital bilateral hip luxation. Waddling but painless walk until he was 25 years old, then bad pains began in his right hip. During the last three years pains in both hips when walking. Ineffective treatment with salicyle, immovable bandage and leather corset, in order to keep the head of the thigh bone down—all this only causes pressure and pains. Trochanter situated 5 cm. above Roser-Nelaton's line on both sides. Whenever the patient moves creaking is heard in both hip joints.

Operation.—January 11, 1906. Ether narcosis. Puncture of the right hip joint. A little clear synovia is found. Injection of 25 c.cm. vaseline.

Course.—Excellent effect; but pains in the left hip joint are getting worse; so the patient returns on January 26, 1907. January 30, 1907: Puncture of the left hip joint. Injection of 25 c.cm. vaseline.

Result: splendid.

CASE XIV.—Mrs. J., aged 66. Admitted August 10, 1906; discharged August 24, 1906.

History.—Malum coxæ dextræ senile, began three years ago. The patient gives the impression of being rather senile. Creaking and grinding is felt in the right hip, which passively can be extended fully. Ineffective treatment with massage, cauterizations, etc. Röntgen photo proves irregular contours of the lowest half of caput.

Operation.—August 17, 1906. Local cocaine anæsthesia. Puncture of the left hip joint. No synovia found. Injection of 20 c.cm. vaselini flavi.

Course—Splendid effect. August 21: Patient gets up and is able to walk without any pains and without grinding.

Result: excellent.

CASE XV.—K. M. N. (farmer's wife), aged 45. Admitted October 4, 1905; discharged January 20, 1906.

History.—Patient, who has a lot of hard work standing up, and who had suffered a long time from nephroptosis, began during the last few years to complain of pains in her right knee while walking and standing. Some creaking noticed latterly. No visible accumulation, no swelling of the capsule, only a good deal of creaking.

Operation.—October 18, 1905. Puncture of the right knee. In spite of hard massage and exercise of the knee not one drop of synovia is found. Injection of 25 grammes vaselini flavi.

Course.—October 19: No pains, but the following week a good deal of tension in the knee. Suppose that too much vaseline has been injected. Massage and strong movements of the knee is tried. December 5, 1905: Patient leaves bed.

Result: medium.

CASE XVI.—I. S. (coachman), aged 61. Admitted Oct. 31, 1906; discharged November 28, 1906.

History.—Patient never felt ill till three or four years ago when he began to suffer pains and lack of strength in the left hip region. His walk became very bad and during the last few

months his right hip has suffered in the same way. Healthy appearance, very tall and thin. In both hip joints strong dry creaking is noticed when moving them to a normal extent. Röntgen photo shows indistinct rough contours of caput femoris on both sides.

Operation.—November 8. Ether narcosis. Puncture of the hip joints. Not one drop of synovia is found. Injection 15 c.cm. vaselini flavi.

Course.—No fever. Insignificant pain in the left hip—the right one quite free from pain and patient is able to move it freely. November 13: Patient gets up. Almost no creaking. Discharged feeling greatly better.

Result: good.

Case XVII.—K.I. (married) farmer. Admitted January 11, 1907; discharged March 12, 1907.

History.—Arthritis traumatica sicca in the right shoulder. Five years ago patient was lifted up by a waterspout and thrown down into a ditch.

Operation.—January 26. Puncture of the right shoulder joint; no synovia found. Injection of 15 c.cm. vaseline.

Course.—No pains and no creaking in the shoulder joint after the injection.

Result: good.

Case XVIII.—M. J. (surveyor), aged 42. Admitted February 23, 1905; discharged April 4, 1905.

History.—Arthritis, traumatica genus d. synovitis; chondritis dessecans. Multiple corpora libera cartilaginea. Patient dislocated his right knee in jumping over a ditch. Bad pains immediately after; they went away after a week's rest but returned a few months later. Since then his walk has been very painful; he feels creaking in the knee, which is often swollen. The furrows on each side of patella are diminished. Patient can bend the knee to a normal extent, with creaking.

Operation.—Ether narcosis. Arthrotomy along the inner edge of patella about 25 c.cm. of turbid tough synovia is evacuated. In the synovia is found many little flat bodies which remind one of broken bits of mother of pearl. Small loss of substance in the joint cartilage. The synovial membrane red, swollen. Irrigation with 4 per cent. carbolic water. Injection of 25 c.cm. vaseline after capsule was closed.

Course.—Healing per primam. During the first month or two rather bad pains are felt when moving the knee, but these vanished gradually and patient has obtained almost normal function.

CASE XIX.—I. J. (farmer), aged 30. Admitted June 28, 1905; discharged July 12, 1905.

History.—A few years ago patient dislocated his left elbow when turning a plough. Since then he has felt uneasiness and increasing difficulty in stretching out his elbow, so that he cannot very well attend to his work. Besides pains there is creaking. No swelling of the capsule, the elbow can be flexed completely but only extended to 140°. Röntgen photo shows a heap of foreign bodies in the articulation, mostly on the flexor side.

Operation.—June 29, 1905. Ether narcosis. Arthrotomia cubiti sin. Plenty of synovia flows out, and at last come a heap of white hard, clinging corpucula aliena. By the aid of the curette more of these are removed. The cartilaginous area look as if pock-marked, with small loss of substance. Chondritis dessecans. Finally, injection of 10 c.cm. vaseline.

Course.—Patient much better but uneasiness is still felt, and the extension of the elbow is somewhat limited. Patient has been able to resume his work.

Result: rather good.

CASE XX.—Miss K., aged 20. Admitted January 24, 1906; discharged April 21, 1906.

History.—Osteochondritis condyli externi femoris dextri. Three years ago patient felt pains and fatigue in the right knee joint. Was in bed for some time with hot water bandage; later on twice in five weeks immovable bandage. Bier treatment, etc. all ineffective. Case grew worse.

Objective Examination.—The leg is kept slightly flexed in the knee; can be bent actively to 90° without much pain. No accumulation. The circumference of the knee is 35 cm. on the round side. Atrophy of 2 cm. on the biggest place of femur and crus. Rather strong creaking by movements.

Operation.—January 28, 1906. Arthrotomia along the lateral edge of the right patella. There appears to be plenty of deep yellow but clear synovia. Condylus externus proves to be the seat of a strange osteochondritis, while the medial one-third of cond. ext. is covered with smooth normal cartilage, the car-

tilage on the outer two-thirds is quite uneven and changed. Across condylus a deep furrow, like a cicatrix, is found in the cartilage; this goes down into the bone for a bit, and here and there appear whitish knots and knobs in the smooth cartilage. The whole of the diseased part of the cartilage is removed with a sharp chisel. The tissue under this is softer than normal, and with curette a part (the size of a walnut), of soft diseased osseous tissue is removed. The remaining part of the articulation surface on cond. ext. is of such a size that sufficient surface against patella and tibia is left. After the bleeding is stopped the capsule wound is sutured and an injection of 20 c.cm. vaseline finally made to prevent ankylosis. Immobilizing dressing.

Course.—The patient's condition on June 17, 1907, almost 18 months after the operation is as follows: She can bend and stretch her knee to the full extent. No pain. Only now and then a soft rubbing is felt in the joint. She is able to dance and ride her bicycle, and there is no lameness.

Result: excellent.

CASE XXI.—C. J., aged 32. Admitted May 28, 1907; discharged July 13, 1907.

History.—Ankylosis art. talo cruralis, seq. fractura tali et malleoli int. Twenty-one months ago patient got badly injured by a fall. At the Kommune Hospital the diagnosis was fracture of malleol. extern. Treated with bandage for a week, followed by walking bandage for three weeks. Patient discharged after six weeks, but walked very badly then by the aid of two sticks. During the first nine months unfit for work owing to pains. The last 12 months he has been able to attend to it but complains of not being able to extend the foot, or to dorsal flex. Ankylosis in a inward rotated position. A prominent bone is felt in the angle between crus and talus.

Operation.—June 11, 1907. Ether narcosis. Incision from malleolus ext. to os cuboideum. No synovia is found in the joint. The prominent piece of bone proves to be a fragment of talus, which has been raised up in front of the articulation line, turned head over heels, so that the top of the articular surface turns downwards. Besides this another much bigger fragment of talus is found dislocated forwards and there fixed in callus matter. This is removed by chisel until the dorsal flection is free. The rest of talus is left. Suture and finally injection of vaseline.

Course.—The progress was quite without reaction. Jan. 30: Patient gets up and sits in a chair. She can move the foot actively and passively without pain. June 12: Is now able to walk with a stick.

CASE XXII.—I. C. N. (grocer's wife), aged 41. Admitted July 27, 1907; discharged August 30, 1907.

History.—Quite well till eight years ago, when patient by degrees felt pains in the right hip joint without preceding considerable trauma. For the last few years patient has not been able to attend to her work in the shop. The pains disappear when lying down, but reappear when starting to walk. Creaking in the joint by movements. No distinct atrophy. Röntgen photo shows caput somewhat flattened, deformed.

Operation.—August 12, 1907. Ether narcosis. Incision is made through the skin, fascia and the muscles to the joint capsule. Puncture is performed. No synovia. Injection of 20 c.cm. of sterile yellow vaseline.

Course.—August 27: Patient gets up. Perfect recovery.

CASE XXIII.—A. J. (stonecutter), aged 41. Admitted September 12, 1907; discharged September 29, 1907. Private clinic.

History.— At the age of 14 patient suddenly began to suffer pains in the left hip region. Treatment for three months with extension and confinement to bed; later on bandage. He got quite well after this and served his time in the army. Three years ago pains and creaking started, especially when going down steps; he often carries heavy burdens. Röntgen photo shows coxa vara.

Operation.—September 14, 1907. In Ether narcosis. The movements of the hip can be done rather easily. Incision through the skin and muscles to the capsule. Puncture. No synovia. Injection of 20 c.cm. vaseline.

Course.—Temperature 38.4° C. the first evening; after that, progress without any reaction.

Result: good.

If we now consider Group II, the *traumatic dry arthritis,* which comprises strictly my two cases previously published and 17 new ones, we find almost constantly such a very satisfactory effect of the vaseline treatment, that those anticipations I cherished with regard to it some time ago, where these forms of arthritis are concerned, can be said fully to be realized.

Here is evidently the real ground for the injection of vaseline, and this is in itself quite natural and obvious when we consider the nature of these diseases. Here is in fact no inflammation. Perhaps we have a formation of fibrous tissue, a fibrous alteration of the synovial membrane, but with the acute traumata this is due to the organization of the clots of blood, to the fibrine deposited on the synovial membrane. In the case of the more chronic traumata, as in the cases of congenital luxation of the hip joint, it is the consequences of the injuries, which by walking are constantly inflicted upon the synovial membrane itself, by pressure, friction, and dragging; and finally by malum senile it is the arteriosclerotic, the senil-atrophic processes, which bring on the fibrous degeneration in the synovial membrane by which the synovia-producing qualities of the same are reduced or extinguished.

By the disappearance of the synovia the surfaces of the bones are left unprotected against pressure and friction and now the usura, the gnawing of the cartilage is beginning, which ends in more or less extended denudation of the bone, and we get the clinical picture of osteo-arthritis. But it is no inflammation really, only the consequences of the absence of synovia in the joint, and to replace the synovia with the vaseline is, in a word, the object of my treatment.

If we now consider these 17 cases of dry traumatic arthritis further, we find 2 patients with congenital luxation of the hip—Cases I and XIII. Case I is that patient who first made me try the vaseline treatment.

In that case the severe pain and the violent creaking, which the deformed, thornapple-like caput femoris produced when walking, completely vanished after the injection of 25 c.cm. of vaseline. Most important it is that this result has now lasted unchanged for *seven* years, the operation having taken place June 6, 1902. While the patient in this case was a woman, 32 years old, with one-sided luxation of the hip, Case XIII is a man, 34 years old, with *double-sided congenital luxation of the hip*. He likewise suffered greatly and was quite unable to work; in his case also the injection of vaseline has had the same excellent effect.

In Case II (also published before) a farmer, 25 years old, the disease was due to chronic overpressure of the left hip, in consequence of a tuberculous coxitis on the right side healed up with ankylosis. The man who was completely unable to work has been well ever since. Together with these three cases still two may be classified, Cases XXII and XXIII, where daily traumatic abuse by overloaded or overworked middle-aged persons produced a dry, creaking arthritis in the hip joint, which was cured at once by the injection of vaseline.

A new but kindred group form 7 cases of malum senile (Cases VII, VIII, IX, XI, XII, XIV and XVI). In Cases VII and VIII it was the two knee joints, in Case XI both shoulder joints of a blacksmith, in the other cases the hip joints, where malum senile was localized.

I stated in my first article, that the injection of vaseline would be expected to have an excellent effect in this disease, which from a pathologico-anatomical view had a likeness to the joint affection described before. This has to a great extent proved to be true, because in one and all of these cases the effect has been excellent and so to speak instantaneous.

In the rest of the 19 cases the question is about dry arthritis, which has developed in accession to all acute trauma, in all probability consequent to the organization of clots of blood deposited on the inner side of the synovial membrane, and by the fibrous alterations of the membrane the synovia-producing ability of the same has been spoiled.

Among these cases we find represented besides the shoulder joint (Cases VI and XVII), the hip joint (Cases III and V), the knee joint (Case IV), and in *one* case (Case X) the jaw joint.

Among these, Case III is a good example of how much can be obtained by this simple treatment. It was a sailor, 22 years old, in whom a dry, creaking and painful right-sided coxitis had developed after repeated strong traumata. After the injection of 20 c.cm. of vaseline all symptoms *of disease disappeared* at once; he could walk without any pain or inconvenience on the sixth day after the operation when he got up, and felt so well that, unknown to me, he enlisted at the board

of conscription for the navy, and without any inconvenience went through the fatiguing training for several months, until the military surgeon one day by chance discovered the scar from the operation.

In Cases IV, VI and XVII a splendid result was obtained. In Case X after the injection of vaseline first in one then in the other joint chamber of the left jaw joint, a great improvement in the condition followed. Only in Case V, the result was inferior, unknown by what reason. It is possible that the case has not been traumatic arthritis. The trauma had here taken place 22 years ago, while the patient stated that the joint affection in her left hip had commenced only 10 years ago; added to this is that her habitus and antecedentia made me suspect uric arthritis. Another possibility is, that the puncture and the injection, which was performed without an incision to the capsule, may have lost its way and completely or partly happened extracapsular.

To these 19 cases of the injection of vaseline in dry traumatic arthritis a special group of 4 cases belongs (including Cases XVIII to XXI), where the vaseline injection has been given *prophylactically* to prevent ankylosis or stiffness of the joint after arthrotomy or arthrectomy.

In the two first cases the question is about that most interesting joint affection following a traumatic injury,—in both these cases a severe distortion of respectively knee and elbow, where a peculiar disease of the joint cartilage is developing, called by a name not at all appropriate, " chondritis dessecans." It is characterized by the following: Round about on its surface little round cartilaginous lamina are burst off, and then accumulated in small heaps, like corpora aliena, in the nooks and corners of the joint, leaving little smallpox-like loss of substance in the joint cartilage. These little bodies are round or oval, flat or convexo-concave, reminding one of the little broken bits of mother-of-pearl one often finds on the inside of mussel and oyster shells.

In both these cases arthrotomy was performed; the corpora aliena were removed by the aid of a little spoon and irrigation. The capsule wound was joined with suture. But

just before this was completed, vaseline was injected in the articulation. Patient XVIII (knee joint) has recovered completely and the recovery has now lasted four years; the other patient, whose left elbow joint was operated on, cannot stretch his elbow to full extent, and complains at times of uneasiness in the articulation, yet he has been able to resume his work as a farmer, and one must say that his condition is wonderfully improved.

In Cases XX and XXI the question is about partial joint resections, which were completed with the injection of vaseline in order to prevent ankylosis. This has been a success in both cases.

The first of these cases was a young lady, 20 years old, with osteochondritis in condylus externus femoris of doubtful origin. The outer two-thirds of the condylus externus had to be removed completely. Just before the last capsule suture was tied, 20 c.cm. of vaseline were injected in the joint. The result was excellent. The patient is now, eighteen months after the operation, able to bend and stretch her knee to the *full extent without any pains*. She can ride her bicycle and walks not at all lame.

The last case concerns a man with ankylosis in the talo-crural joint, consequent to a fractura tali et malleoli int. After the removal of the fragmina and the callus, vaseline was injected in the joint, which, by the by, was closed with suture without drainage. The wound healed per primam intentionem with good mobility.

There is no doubt that the injection of vaseline can be used like this with success to prevent ankylosis after joint re-sections on articulations not infected, which can be closed completely without drainage at the conclusion of the operation. Whether this method can be utilized in the resection of tubercular joints, elbow, shoulder, and foot joint, where it is of importance to preserve the mobility, is another question,—but I hope it will.

THE TECHNIC.

In conclusion, a few words about the technic of injection of vaseline in the joints. In my first article I pointed out that this little operation, if not performed strictly correct, could

Fig. 1.
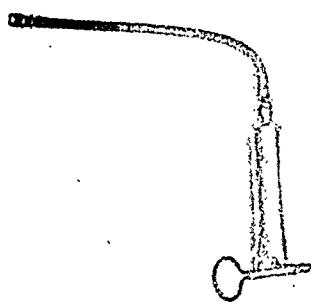
Vaseline tube with closed rubber drain for boiling.

Fig. 2.
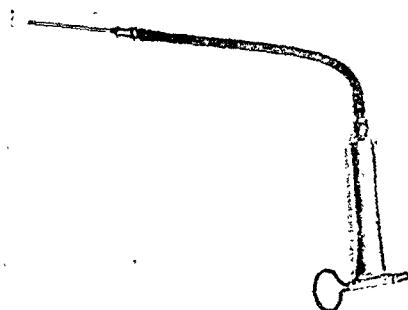
The cover removed and the cannula screwed on the drain.   Apparatus ready for injection.

perhaps involve danger to the patient in two ways: by *embolism* and by *infection*. A vaseline embolus can only occur if the cannula is caught in a blood-vessel and the injection happens into this. This accident can, however, be avoided by making the puncture with a blunt cannula with *poinçon*. Not until you have removed the *poinçon* and seen that no blood is running from the cannula, and that the latter is quite movable inside the articulation, can the injection take place. To secure an absolutely aseptic state of the vaseline I have the following manner of proceeding:

I have had a special apparatus made: (see Fig. 1) a tube of india rubber 10 cm. long, which at one end is provided with a brass ring which can be screwed on to the ordinary vaseline tubes, while the other end can be partly screwed into the cannula and partly into a close fitting cover, which fits the cannula and during the boiling can be closed with a little cover; provided with this cover the rubber tube is screwed on to the vaseline tube and is now boiled together with this for 15 minutes before the injection. Then the joint is punctured, the *poinçon* is removed, and the presence of synovia in the joint ascertained. In such a case catch the synovia in sterile glass tubes for examination. If it is found to be turbid and fluffy the injection of the vaseline is abandoned, but if none or only an inferior mass of clear synovia is found, the vaseline tube is taken direct from the cooking vessel and connected with the cannula by the connection tube, which after the cover has been removed can be screwed straight on to the cannula. The vaseline is now driven through the tube and cannula in this way: the vaseline tube is rolled up from the bottom by the aid of a tiny little handle (Fig. 2).

By this means every possibility of infection of the vaseline passing from the tube to the joint is precluded, and the method is in every respect practical. The whole thing would be even more simple if one dared use the edge-tool cannula, as then before the puncture this could be gathered with the rubber tube. But for several reasons I have rejected this manner of proceeding,—first because there is no assurance against emboli,

and secondly because the operator is excluded from ascertaining whether there is synovia, and if so, what is its nature.

I puncture the *shoulder joint* by leading the trocar under the hindmost corner of the acromion; the *knee* by puncture outwards at the upper corner of patella. As regards the *hip joint* I have in most cases insured against missing the joint by exposing the joint capsule through an incision, 4 to 5 cm. long above the point of the trochanter. The capsule of the jaw joint I expose by the aid of a transverse incision under arcus zygomaticus. I consider this quite necessary, if one is to proceed safely and know what one is doing.

There is still one more very important question regarding technic, and that is what *quantity* of vaseline one is to inject in the different joints. Every guide was missing here, as I did not succeed in finding any examinations and reliable statements in cubic centimetres of the normal quantity of synovia in the different articulations of the body. I therefore had to experiment as I progressed.

The most roomy joint is the hip joint, which in adults takes 20 to 25 c.cm. of vaseline without any difficulty. While I had the luck here to find somewhat the right quantity, I greatly overestimated the capacity of the knee joint, as I suggested using 20 to 25 c.cm. here also, thinking that the knee joint would likely be able to hold more than the hip joint. That was a mistake which betrayed itself by the joint becoming distended and sore, so that in two cases I had to evacuate by a new puncture half the quantity of the vaseline injected, before obtaining a good result.

Ten to 12, at the very most 15 c.cm. is after my experience the suitable quantity for the knee joint. In exceptional cases, where one has removed parts of the end of the bones, as in Case XX, a larger quantity is of course wanted.

For the shoulder joint 15 c.cm. are considered suitable as a rule. The spot where the puncture has taken place is covered with collodion and absorbent cotton, and where no incision has taken place I let the patient begin to use the articulation at once.

THE LYMPHATICS OF THE COLON.

BY J. KAY JAMIESON, M.B.,

Demonstrator of Anatomy in the University of Leeds.

AND

J. F. DOBSON, M.S., F.R.C.S.,

Senior Assistant Surgeon to the Leeds General Infirmary.

OF LEEDS, ENG.,

DURING the last four years we have been engaged on a research on the lymphatics of the alimentary canal, preparing for the purpose a large number of specimens injected by Gerota's method. Our material was drawn from subjects of all ages—chiefly children and young adults—as, except in the case of the appendix, fetal specimens are not very satisfactory. Previous work on the lymphatics of the colon had not shown the position of the primary glands and had done no more than furnish vague statements that the lymphatics ran with the blood-vessels. In April, 1907, our observations on the lymphatics of the cæcum and appendix were published,[1] and in March, 1909, we gave an account of the vessels and glands of the colon.[2] In these papers we indicated for each part of the large intestine the extent of the operation which the anatomical facts demanded. Recent papers on the subject appear either to ignore the necessity of complete removal of lymphatic areas or to recommend operations based on a faulty conception of the anatomy of the lymphatics. The methods of operation for cancer of the colon outlined in the following pages have been practised without any special difficulty and without mortality.

The Necessity for Removing Lymphatic Glands in Cases of Cancer of the Colon.—No operation for malignant disease can be considered complete without the removal of lymphatic

glands. In the colon, as elsewhere, cancer gives rise to secondary gland disease, though it is accepted that this gland invasion may be late or even absent (Treves,[3] de Bovis[4]). In many cases it is overshadowed by secondary visceral disease. The glands may be enlarged from inflammatory disease without malignant infiltration (Bilton Pollard[5]). H. S. Clogg found cancerous deposits in the lymphatic glands in 28 out of 45 cases of malignant disease of the cæcum and colon.[6] Recurrences are known to be frequent after colectomy (de Bovis, Clogg); some no doubt are due to visceral disease unmasked at the time of operation: other recurrences are indubitably glandular. It is impossible for the surgeon to determine at the time of operation whether a growth in the colon has given rise to secondary gland infection or not. To minimize as far as possible the likelihood of recurrence, it is necessary to remove with the primary growth those glands which are likely to have become affected. The primary glands—those receiving direct vessels from the gut—will be the first to become diseased by cancerous emboli carried to them along the lymphatic vessels from the primary growth, and any one primary gland is just as likely to become affected as another, whatever may be their comparative position with regard to the colon. In those portions of the colon supplied by long arterial arcades the paracolic glands at some little distance from the seat of the disease may become affected; this applies in particular to the transverse colon and to a lesser extent to the ascending and descending colon. The lymphatic vessels which emerge opposite the centre of the arcade have to travel in one direction or the other for a considerable distance parallel to the gut before they reach an arterial trunk along which they can pass towards the main groups. These vessels enter some paracolic gland on their way, while a vessel issuing opposite the trunk of one of the larger colic arteries would, after the same length of course, have reached an intermediate or even a main group gland. It is evidently necessary to remove the paracolic glands for some little distance on each side of the primary growth, and this necessitates excision of a

considerable length of gut; in particular this applies to the transverse colon.

The ideal operation consists in removing a considerable length of gut on each side of the growth, the primary glands, together with the vessels running to them from the gut, and the tissues in which these vessels lie—*i.e.*, the so-called "lymphatic area."

In some situations it is impossible to remove the whole of the lymphatic area—*e.g.*, at the splenic flexure. In removing the primary glands many of the secondary glands will be included, but the secondary glandular system of any part of the colon is too extensive to permit excision. In certain cases it may be found that although the local conditions are favorable for excision, glandular hypertrophy has extended beyond the primary glands and has involved the secondary glands. If the secondary glands are certainly malignant it would appear to be useless to proceed with the operation, except as a palliative measure. The difficulty of determining malignancy in any given enlarged gland must, however, be borne in mind, and where there is the least doubt the growth with the primary glands should be excised in the hope that the enlargement of the remaining glands may be due to absorption from the ulcerated surface in the bowel, and not to malignant infiltration. That is to say, in every case in which the local and general conditions are favorable, the growth with the corresponding lymphatic area, or as much of it as is possible, should be excised apart altogether from the presence or absence of enlargement of lymphatic glands.

The Lymphatics of the Large Intestine.—The lymphatic glands of the large intestine (Fig. 1) are scattered along the course of the blood-vessels and may be described in chains corresponding to these vessels, viz.: the ileocolic chain, the middle colic chain, the left colic chain, and the inferior mesenteric chain. In each chain, at certain points the glands tend to form groups which owing to the presence of scattered

glands between them, are not sharply defined from each other; it is convenient for purposes of reference to name them, epicolic, paracolic, intermediate, and main groups.

The *epicolic glands* lie on the intestinal wall, often in the bases of the appendices epiploicæ, and are most numerous on the sigmoid flexure. They are small and unimportant and will not be mentioned in the description of the various chains.

The *paracolic glands* lie along the gut on the vascular arcades and the short straight terminal vessels proceeding from the arcades.

The *intermediate glands* are situated about midway between the arcades and the origins of the colic and sigmoid vessels.

The *main group glands* surround the stems of the vessels near their origin.

The ileocolic chain (Fig. 2) drains the lower end of the ileum, the cæcum and appendix, and the greater part of the ascending colon. Its paracolic glands lie along the inner side of the ascending colon (right juxtacolic glands), in the ileocolic fold (anterior ileocolic glands), and behind the ileocolic junction (posterior ileocolic glands). The intermediate glands lie on and above the point of division of the ileocolic artery into its various branches. The main group lies on the upper part of the artery and therefore partly in front of the duodenum. The scanty chain of glands lying on the right colic artery joins the main group of the ileocolic chain. The vessels from the ascending colon, cæcum and appendix, and terminal part of the ileum are not all intercepted by the paracolic glands; many proceed to the intermediate glands and a considerable number to the main group. Meso-appendicular glands are merely prolapsed members of the paracolic or intermediate groups, and their presence or absence is of no importance. There is no communication between the ovarian lymphatics and a meso-appendicular gland.

THE OPERATION FOR MALIGNANT DISEASE OF THE CÆCUM, AND LOWER PART OF THE ASCENDING COLON (Fig. 3).—In cases for radical treatment the operation necessitated

FIG. 1.
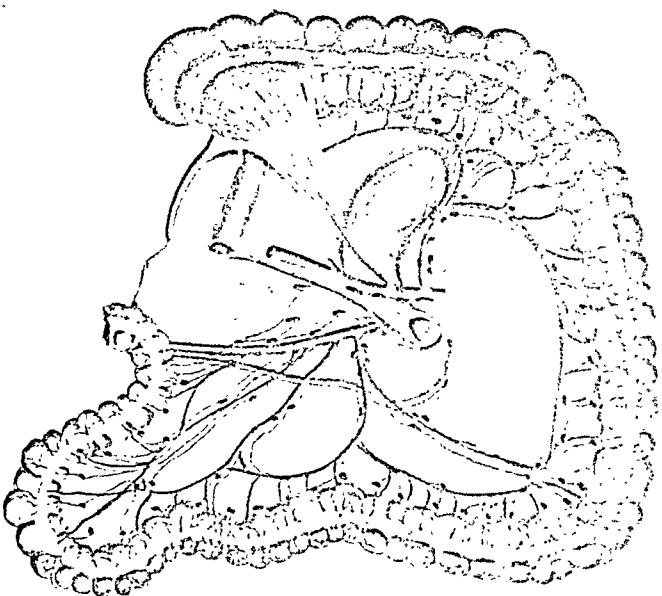
The lymphatics of the colon. (Proc. Roy. Soc. of Medicine.)

FIG. 2.
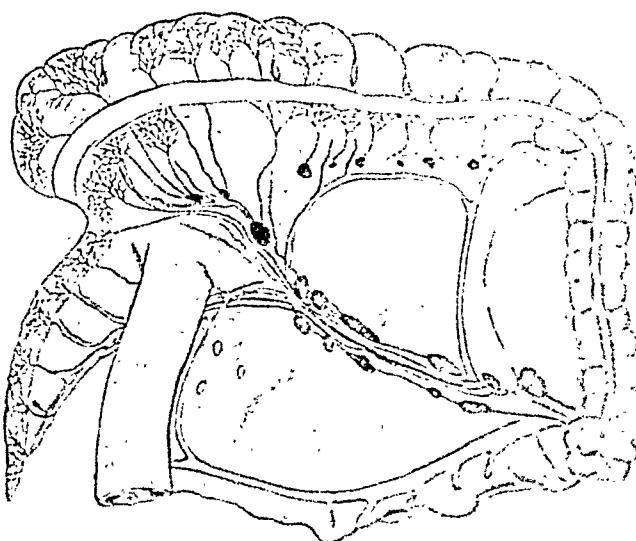
Lymphatics of the cæcum and appendix.   Anterior view.
(Lancet, Apr. 27, 1907.)

by the arrangement of the lymphatics is, viz.: After exposing the field of operation the lower border of the third part of the duodenum is defined. The peritoneum over this is divided and the ileocolic vessels are found. The fatty tissue surrounding the vessels which will contain the uppermost gland of the ileocolic chain is stripped downwards with gauze, care being taken not to wound the duodenum. The artery and vein are ligatured and divided close to the superior mesenteric artery. It is well at this stage to select the point on the transverse

FIG. 3.
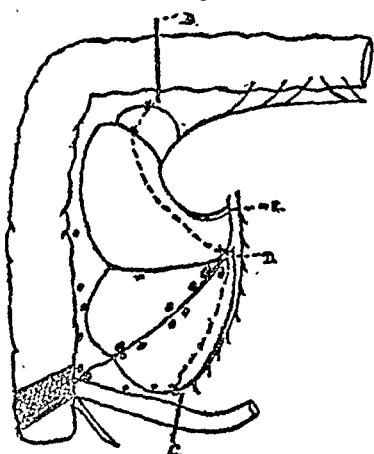
FIG. 4.

Excision of growth in the cæcum. A, growth; B, line of section of transverse colon; C, line of section of ileum; D, point of ligature of ileocolic artery; E, middle colic artery.
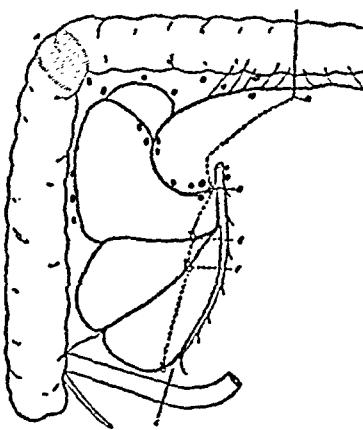
Excision of growth at the hepatic flexure. A, growth; B, line of section of transverse colon; C, line of section of ileum; D point of ligature of middle colic artery; E, point of ligature of right colic artery; F, point of ligature of ileocolic artery.

colon where the gut shall be divided. The transverse mesocolon is then divided up to the selected point, some branches of the middle colic artery being secured. The middle colic artery itself is carefully preserved. If the right colic artery has a separate origin from the superior mesenteric it will need ligature. The peritoneum of the mesentery is then divided in an oblique line downwards to the ileum. The ileocolic and right colic vessels, with the accompanying chain of glands, the fatty tissue and the overlying peritoneum, are then stripped downwards to the ileum and cæcum and outwards to the colon. The ureter and spermatic vessels are encountered and

must be avoided. The cæcum is then lifted up and the peri-
toneal reflection to the outer side of the colon is divided.
The cæcum and appendix, the whole of the ascending colon,
and the terminal portion of the ileum, with the ileocolic and
right colic vessels and the lymphatic chain, can then be with-
drawn from the abdomen, only remaining attached by the
continuity of the intestine. The colon is divided at the
previously selected point and the ileum about six inches from
the valve. The operation is terminated by an ileocolostomy
to the transverse colon, or—as was necessary in one of our
cases—to the sigmoid colon.

The *Middle Colic Chain* drains the area of distribution of
the middle colic artery—the upper part of the ascending colon,
the hepatic flexure and about two-thirds of the transverse
colon. The paracolic glands are disposed in the manner
already mentioned; the intermediate group lies on the artery
just above its bifurcation about midway between the bowel
and the root of the mesocolon: the main group is placed on
the stem of the artery at the root of the mesocolon in front
of the head of the pancreas, sometimes blending with the
superior mesenteric glands. Direct vessels reach the inter-
mediate group in all cases and the main group in many, but
only from the hepatic flexure, the upper part of the ascend-
ing colon and the right end of the transverse colon. The
vessels from the central portion of the transverse colon are
all intercepted by the paracolic glands.

OPERATION FOR GROWTHS IN THE NEIGHBORHOOD OF THE
HEPATIC FLEXURE (Fig. 4).—Growths in this situation are
not uncommon but are rarely removable as they quickly be-
come adherent and fixed to neighboring structures—pancreas,
duodenum, etc. To remove the " lymphatic area " it is neces-
sary to tie the middle colic artery at its origin from the
superior mesenteric and to remove the mesocolon from this
point up to the bowel. By this step the whole of the middle
colic chain of glands is secured. Ligature of the artery
devitalizes so much of the ascending colon—particularly in
those cases where the right colic artery has origin from the

middle colic—that it is necessary to remove the whole of the ascending colon, with the cæcum and terminal six inches of the ileum, the growth at the hepatic flexure and about half the transverse colon, completing the operation by a lateral anastomosis between the ileum and the transverse colon.

The Left Colic Chain.—The paracolic glands lie in the usual situation. The intermediate group is scattered, but the majority of the glands lie on the artery just above the point where it is crossed by the inferior mesenteric vein, in front of the inner border of the kidney. The main group is divided: one part lies on the left colic trunk close to its origin, the other part on the curved upper end of the inferior mesenteric vein, and is continuous with the glands about the head of the pancreas (superior mesenteric and lumbar). Direct vessels from the splenic flexure reached the intermediate group in 4 out of 14 of our specimens, and from the descending colon in 5 out of 15. We have never seen a direct vessel passing to either part of the main group.

From the greater part of the transverse colon the vessels enter the paracolic glands; they run parallel to the gut along the arterial arcade in either direction, and are invariably intercepted after a longer or shorter course by these glands. We have never seen them enter even the intermediate groups of the middle or left colic chains. It is only as we approach the flexures that we find vessels passing by the paracolic glands.

In the left half or two-thirds of the transverse colon there is an additional outlet for the lymph. In well-injected specimens we find that vessels arise from the anterior surface of the colon, run into the gastrocolic omentum, and then turn to the left between the ascending layers of this fold to reach, finally, the glands at the hilum of the spleen. The vessels from the middle of the transverse colon are necessarily very long, and there may be small interrupting nodules on them. We have also noted in two cases vessels ascending from the back of the upper end of the descending colon (lower limb of the splenic flexure) to the splenic glands.

OPERATION FOR GROWTHS IN THE MIDDLE PORTION OF THE TRANSVERSE COLON.—We have noted above that the lymphatics of this segment are all intercepted by the paracolic glands. The removal of a length of bowel (3 to 4 inches), on either side of the growth with the corresponding portion of the mesocolon containing these glands, will suffice. It should be possible in all cases to preserve so much of the transverse colon as will permit an end-to-end anastomosis.

OPERATION FOR GROWTHS IN THE REGION OF THE SPLENIC FLEXURE (Fig. 5).—The left colic artery is defined as it leaves the inferior mesenteric vein, and is tied at this point
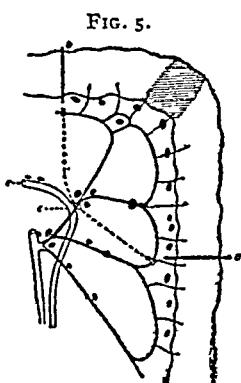
FIG. 5.
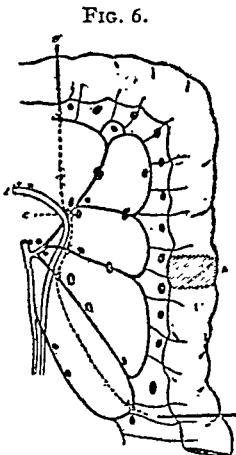
FIG. 6.

Excision of growth in the splenic flexure. A, growth; B, line of section of transverse colon; C, point of ligature of left colic artery; D, line of section of descending colon; E, inferior mesenteric vein.

Excision of a growth in the descending colon. A, growth; B, line of section of transverse colon; C, point of ligature of left colic artery; D, line of section of sigmoid flexure; E, inferior mesenteric vein.

with the accompanying vein. The bowel is then freed by incising the peritoneum to the outer side of the descending colon and splenic flexure and separating the bowel with the growth, the peritoneum and the subperitoneal tissues containing the lymphatic glands and vessels from the posterior abdominal wall. The mesocolon is then divided from the point of ligature of the artery, upwards to a selected point on the transverse colon. The selection of this point will be determined by the extent of the transverse colon supplied by the middle colic artery; it will lie as a rule at the junction of

the middle and left thirds of the transverse colon. The peritoneum is also divided in a direction downwards and outwards to the descending colon. At the selected point on the transverse colon the bowel is divided; below, the descending colon is divided in its lower part and the operation is completed by an end-to-end anastomosis.

OPERATION FOR GROWTHS IN THE DESCENDING COLON (Fig. 6).—The "lymphatic area" corresponding to this part of the colon comprises the epicolic and paracolic glands and the intermediate glands on the branches of the left colic artery, including those on the uppermost sigmoid artery. Some vessels also run to the splenic glands, as in the case of the splenic flexure. It will then be necessary to tie the left colic artery at the point where it leaves the inferior mesenteric vein, and also the uppermost sigmoid artery close to its origin. A reference to the diagram will show that beyond this step the operation is much the same as that for the splenic flexure except that, below, the gut will be divided in the upper part of the sigmoid flexure.

The Inferior Mesenteric Chain.—This chain of glands drains the sigmoid flexure and rectum. The paracolic glands lie in the position described above. The intermediate glands lie on the sigmoid arteries—those on the highest sigmoid branch being found between the lower end of the kidney and the iliac crest, those on the other branches in the root of the mesosigmoid. The main group surrounds the inferior mesenteric stem below the origin of the left colic chain, both chains becoming continuous with the lumbar glands at this point. Direct vessels reach the intermediate glands in all cases. The lower end of the main group necessarily lies near the intestine at the pelvic brim and is comparable to the paracolic group in other parts, receiving therefore numerous direct vessels. The middle portion of the chain is in series with the intermediate glands on the sigmoid arteries and receives direct vessels, but the upper part of the chain never receives vessels directly from the gut, resembling in this respect the main group of the left colic chain. From

all parts of the group vessels pass to the lumbar glands (Fig. 7).

THE OPERATION FOR GROWTH IN THE LOWER PART OF THE SIGMOID FLEXURE AND THE FIRST PART OF THE RECTUM (Fig. 8).—This may conveniently be considered before we discuss the operation for a growth in the middle of the sigmoid flexure. The glands requiring removal are those lying around the inferior mesenteric artery and its continuation, the superior hæmorrhoidal artery, from the point of origin of the left colic artery downwards,—this includes all the primary lymphatic glands. It is not necessary to remove the

FIG. 7.
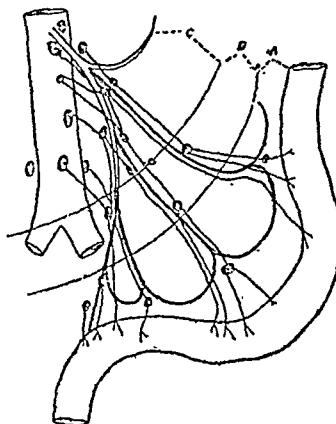
Showing how the lowest and middle glands of the inferior mesenteric chain are homologous with the paracolic and intermediate groups on the sigmoid arteries. *A*, paracolic group; *B*, intermediate group; *C*, main group.

glands around the stem of the inferior mesenteric artery above the point of origin of the left colic artery; these glands are not primary glands and are indeed less likely to become diseased from a growth in the situation we are now considering than are the lower glands of the lumbar group. Further, if these glands are secured by ligaturing the inferior mesenteric stem close to its origin from the aorta, the blood supply of the upper segment of bowel will then depend entirely on the anastomosis between the left colic and middle colic arteries, which may be insufficient.

The operation consists in exposing the inferior mesenteric artery and ligaturing it and the vein just below

the point of origin of the left colic artery. A long incision through the peritoneum is made on the outer side of the mesorectum, mesosigmoid, and descending colon, and the gut mobilized by stripping it inwards towards the middle line. In doing this the ureter and spermatic vessels are encountered and must be avoided. The mesosigmoid is then divided in an oblique line downwards from the point of ligature of the inferior mesenteric to about the middle of the sigmoid flexure, care been taken to preserve as far as possible the secondary arches on the sigmoid arteries. The peritoneum

FIG. 8.
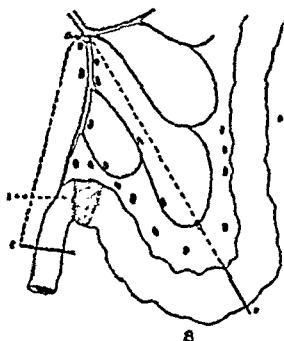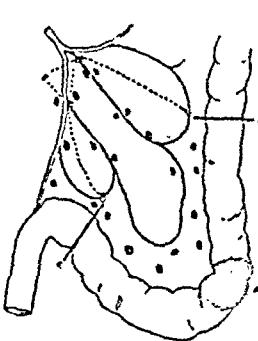
Excision of a growth at the junction of the sigmoid flexure and the rectum. *A*, growth; *B*, line of section through the sigmoid flexure; *C*, line of section through the rectum; *D*, point of ligature of the inferior mesenteric artery.

FIG. 9.

Excision of a growth in the middle of the sigmoid fixture. *A*, growth; *B*, line of section above the growth; *C*, line of section below the growth; *D*, the sigmoid arteries tied at their origin. (Proc. Roy. Soc. of Me .)

to the inner side of the artery is then divided downwards to the inner side of the mesorectum. The mass of tissue to be removed is then stripped forwards from the sacral hollow and the middle sacral artery is secured. The peritoneal reflection from the bladder to the rectum is divided.

The operation may be terminated in one of three ways. (*a*) By cutting across the rectum below and the sigmoid flexure above, closing the rectum by sutures and effecting a permanent colostomy,—an undesirable method but one which will be necessitated in a certain, perhaps considerable, proportion of cases. (*b*) By dividing the rectum and sigmoid colon as above and effecting an anastomosis from within the abdomen. The vitality of the lower segment depends on the

middle and inferior hæmorrhoidal arteries and branches of the sacral arteries. We have not yet enough evidence that these are sufficient in all cases to permit the retention of a length of the rectum necessary for the performance of an anastomosis. (*c*) By making a perineal incision, pulling the whole mass of tissue through the outlet of the pelvis and anastomosing the middle of the sigmoid flexure to the anal stump (Maunsell, Tuttle, etc.).

Of these three methods the third appears to be the best. There will be many cases, however, where owing to the poor condition of the patient, to excessive stoutness, to distention of the bowel, etc., it will be impossible. In such cases a colostomy is indicated. In cases where an iliac colostomy has been done previously on account of obstruction, although it may be possible to close the opening and effect an anastomosis after resection of the growth, it will probably be wisdom to preserve the colostomy permanently.

OPERATION FOR GROWTHS IN THE MIDDLE AND UPPER PART OF THE SIGMOID FLEXURE (Fig. 9).—The lymphatic glands receiving direct vessels from this part of the colon include the epicolic and paracolic glands, the intermediate glands lying on the sigmoid arteries in the mesosigmoid, and the main group glands on the inferior mesenteric artery. The " ideal " operation in these cases is practically the same as that described above, with the difference that more of the mesosigmoid will be removed and the gut will be divided above at the junction of the descending colon and the sigmoid flexure. This " ideal " operation will be terminated in a certain proportion of cases by a permanent colostomy, and it must be remembered that the purely local excision of growths in this situation, with preservation of the alimentary circulation, has been attended with a considerable measure of permanent success. If the " ideal " operation necessitates a colostomy the comparative disadvantage is so enormous that it will rarely be performed. Being unwilling to consider even the possibility of a permanent colostomy after excision of a growth in the middle of the sigmoid flexure, we must

perform an operation which if short of the ideal does remove the majority of the possibly affected glands.

The operation consists in exposing the inferior mesenteric vessels, dividing the peritoneum over them and stripping off as many of the glands of the main group as is possible without damaging the vessels. This is done from the point of origin of the left colic artery down to the origin of the lowest sigmoid artery. The sigmoid arteries are tied at their origin, the lowest being preserved if its ligature be not necessitated by the position of the growth. The descending colon is then mobilized and the gut divided above at the junction of the descending colon and the flexure, and below in the lower part of the flexure. Almost the whole of the mesosigmoid will thus be removed, including the intermediate, paracolic, and epicolic glands and probably the greater number of the main group glands corresponding to this part of the sigmoid flexure. The operation is terminated by an end-to-end anastomosis between the end of the descending colon and the lowest part of the sigmoid flexure. If it is found necessary to tie the lowest sigmoid artery at its origin care must be taken to divide the gut well below the level of the brim of the pelvis, in order to avoid the " dead end " which may be left, as Manasse and Archibald have shown, owing to the non-union of the branches of the lowest sigmoid and superior hæmorrhoidal arteries.

In a recent paper, Dr. W. J. Mayo[7] gives diagrams of suggested operations for cancer of the colon, designed to remove the associated lymph-glands. He does not give any reference to the writings or specimens on which his anatomical descriptions are based, and the accuracy of these is open to criticism in many respects. We may note that the tendency of the lymph drainage of the descending colon is not towards the transverse mesocolon, following the middle colic tributaries, as Dr. Mayo states; the lymphatic vessels run with the left colic artery. The lymph drainage of the splenic flexure and adjacent transverse colon is in the opposite direction to that of the hepatic flexure and the greater part of the

transverse colon. Their direction would only be the same if the middle colic artery supplied the whole of the transverse colon, including the hepatic and splenic flexures, which is not the case.

In Dr. Mayo's diagrams (Figs. 7 and 8 in his paper[7]) showing the lines of the proposed resection of the sigmoid, it will be noted that a considerable loop of sigmoid colon is shown to be left, below the portion which is resected. As the inferior mesenteric artery has been tied the blood supply of this loop depends entirely on the middle and inferior hæmorrhoidal arteries and on twigs from the sacral arteries; it is questionable whether this will suffice for such a length of bowel as is depicted.

REFERENCES.

[1] Jamieson and Dobson: Lancet, Lond., 1907, vol. i, pp. 1061, 1137.
[2] *Idem:* Proceedings of the Royal Society of Medicine, London, March, 1909.
[3] Treves: Intestinal Obstruction, 1899.
[4] de Bovis: Rev. de Chir., 1900, xxi, pp. 673, and xxii, pp. 49, *et seq.*
Pollard, Bilton: Brit. Med. Jour., 1904, i, p. 175.
Clogg, H. S: Practitioner, Lond., 1904, lxxii, p. 525, and Lancet, 1908, v, ii, p. 1007.
Mayo, W. J: ANNALS OF SURGERY, July, 1909.

SOME CONSIDERATIONS UPON HIGH AMPUTATION OF THE RECTUM.

BY HENRI HARTMANN, M.D.,

OF PARIS, FRANCE,

Professor in the Faculty of Medicine of Paris.

AFTER high perineal amputations of the rectum we have twice seen gangrene of the terminal portion of the intestine that had been brought down, and in several cases after perfect operative recovery we have observed recurrence in the connective tissue of the pelvis even when the mucous membrane remained intact. In these two series of cases in which there was either primary gangrene of the rectum or secondary recurrence in the connective tissue, we had to do with patients in whom we had been obliged to cut the hemorrhoidal arteries quite high up, either because the cancers were located high in the ampulla, or the cancer—though seated lower down upon the mucosa—was accompanied by an infiltration of the meso-rectum by the neoplastic extension. It is not rare to see in such cases, once the prerectal peritoneal cul-de-sac has been opened, the rectosigmoid portion present itself and permit itself to be easily drawn down, while the rectum proper, especially its ampullary portion, remains fixed, being held firmly by the superior hemorrhoidal branches which descend in a straight line from the aorta. In order to make possible the coming down of this portion of the intestine, it is absolutely necessary to cut the superior hemorrhoidal vessels. It is then easy to draw the rectum outside; but, as far as can be seen, there develops a consecutive gangrene, the pathogeny of which is explained by the anatomy of the vascular system of the region, the arterial circulation of the rectum being very different from that which is present in other portions of the intestine. While in the latter there are present a series of anasto-

motic loops, upon the rectum one sees the hemorrhoidal arteries descend without forming the slightest anastomotic loop.

This has been well shown by the researches pursued at my suggestion by de Dietrichs, in my laboratory. The injections which he has made indicate: First, that the ligature of the inferior mesenteric artery does not affect the circulation of the rectum, provided it be done between its origin and the giving off of its last important collateral branch which arises from 1 cm. to 1½ cm. below the promontory (see Fig. 1).

FIG. 1.
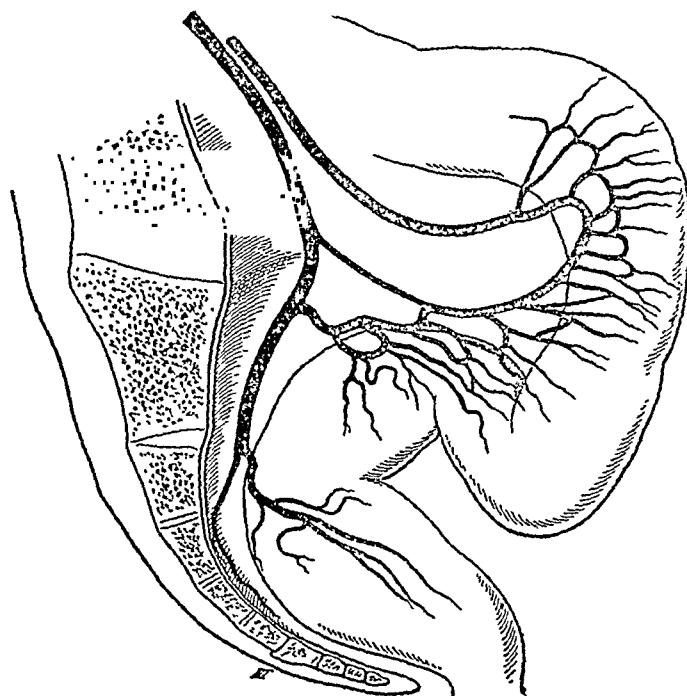
Arterial circulation of the rectum.—Note the difference in the arrangement between the arteries of the pelvic colon, which form an anastomotic loop, and the superior hemorrhoidal arteries, which present no important anastomosis. Note the constant situation of the last anastomotic loop, a little below and to the left of the promontory.

Second, that the ligature of the terminal portion of the inferior mesenteric below this last collateral branch produces almost complete suppression (or even complete) of the arterial supply of the rectum and of the rectosigmoid junction. The suppression is so much the more complete since in the course of the perineal amputation one separates the lower part of

the intestine from its peripheral connections, and since one cuts consequently the branches of the middle hemorrhoidal artery,—an accident less important indeed than the descriptions in recent treatises on anatomy would lead us to suppose. Third, that ligature of the trunks of the superior hemorrhoidal artery, right and left, produces suppression of the circulation in corresponding sides of the rectum. In a way, the superior hemorrhoidal arteries answer to the type of terminal arteries.

The results of these researches, in great part confirmative of those published two years ago by Sudeck (*Muench. med. Woch.*, 1907, pp. 13, 14), are that if the operator wishes to have an intestine which may be brought down to the level of the skin of the perineum without traction and still well nourished, it is necessary to avoid cutting the hemorrhoidal arteries at the point where one is led necessarily to divide them when working exclusively from the perineum. It is necessary to place a ligature high up on the common trunk of these arteries above the last anastomotic loop which, as we have said, is found a little lower than the promontory, and it is necessary to tie both ends, the blood flowing back in abundance by the inferior end. In consequence of not having done this last ligature we have lost a patient from hemorrhage.

The necessity of making this high ligature of the hemorrhoidal pedicle, obliges one to begin the operation through the abdomen, whereby the advantage is gained of being able to divide immediately, along the sides of the rectum, the peritoneum and the subjacent fibrous tissue which with the hemorrhoidal pedicle forms the chief source of fixation of the upper part of the rectum. The same path will be utilized also to strip up from in front whatever infected connective tissue surrounds the rectum, blood-vessels, lymphatics, and glands. At the same time while the operator will be protected from the danger of secondary gangrene, he will have accomplished an extirpation much more extensive than by the ordinary procedures through parts which may be invaded by the cancer. This done, he will have only to finish the operation by isolating through the perineum the lower part of the rectum, as one

does for low amputations of this segment of the intestine, and to bring it down until the outside portions shall be manifestly healthy. This is possible in a great majority of cases without the least traction, in consequence of the straightening out of the sigmoid flexure. However, when the meso of this loop is short, the intestine may be seen to descend vertically into the pelvis, like a clock pendulum, isolated on all sides, which is a bad condition for ultimate cure. The intestine ought, at the end of the operation, to be in contact with the neighboring parts, resting directly on the sacral concavity and following its curvature in such a manner that it may readily and quickly become adherent to the neighboring parts. To accomplish this in cases of shortness of the mesosigmoid, it is necessary to incise the peritoneum alongside the colon in such a way as to mobilize downward and toward the median line the intestine with its vascular meso preserved intact. One may also cut the intestine across, fix its upper end in an iliac incision and extirpate the lower end in totality.

By following the technic that we have just indicated, the operator is able to prevent gangrene of the end of the intestine and will make a much wider removal of the cancerous growth along the lymphatic paths, realizing what one might call by analogy with the operations recently done for uterine cancer, wide ablation of cancer of the rectum.

It is true that up till now the results of abdominal and perineal amputations of the terminal parts of the intestine have not been very encouraging. We believe, however, that with the actual improvement of the technic they will become better, and that the abdominoperineal path is to be the path of the future. Personally, we have in these recent days done this abdominoperineal operation four times,—three times bringing down the pelvic colon through the perineum and once the upper end in an iliac incision and total extirpation of the lower end. We have had three cures and one death by hemorrhage (case mentioned above), the result of an operative fault which it should be possible to avoid.

PRINCIPLES OF A RADICAL TREATMENT FOR PROCTOSIGMOIDITIS.

BY PROF. DR. RAFFAELE BASTIANELLI,
OF ROME, ITALY.

In recent years I have met with a relatively large number of cases commonly called strictures of the rectum, but which really involved greater problems than those connected with a simple stricture. Treatment of these cases is not in great favor among surgeons owing to the difficulties and failure of routine methods, and for that reason I wish to submit to the profession some principles and observations relating to this kind of case.

The ætiology and pathogenesis of the rectal stricture has been much discussed. Especially after Virchow's description, they have been called, without discrimination, syphilitic. Virchow truly said that the syphilitic nature of these strictures was admitted by him for analogy with the chronic ulcerations and narrowing scars produced by syphilis in the larynx; but he could not say (having never seen it) how it begins— whether with gummata or with condylomata; and in many cases he would be embarrassed to decide between syphilitic, diphtheritic, and dysenteric ulcerations,—only he knew that the first had a lower situation and were more regular and flat. Clinically, too, for a while it was assumed that these lesions were syphilitic, because of their greatest frequence in syphilitic persons and in prostitutes; but later it was found that in some instances lues was surely to be excluded, in many others no anatomical proof could be given of their luetic nature, and in none specific treatment was ever of any benefit.

Next it was discovered that some cases are tubercular, some consecutive to morbid processes outside of and near the rectum,—and for others blennorrhagia was held responsible. But in many instances the true explanation was lacking, and for these was admitted the existence of a proctitis of no

definite nature arising from many possible common causes,— and this idea was so extended by some as almost to exclude syphilis from the great majority of cases. Among my observations I find that abnormal sexual intercourse had in almost every instance taken place either occasionally or habitually, so that it could easily be assumed that this was the most common way of the infection, whatever it may be. But it was impossible to find any bacteriological or anatomical proofs to support the view that the blennorrhagic infection was the primary one, notwithstanding my feeling and tendency to give to it a great part. Tubercular origin was never found among my cases, and I believe that the presence of giant cells with leucocyte accumulation, even in form of so-called follicles, has no decisive importance in defining the nature. Once the stricture was consecutive to dysentery. In the major number of cases the anatomical findings were greatly in support of syphilitic origin, but how they can be demonstrated I will leave for another occasion—being a too long discussion and too far from the principles of therapy, which I will resume.

No treatment can be claimed to be the sole one for these cases. The sound principle to guide one, is that the anatomic conditions of each instance only can bring us to a rational therapy. Prominent among the anatomic conditions is not to be considered the stricture itself but the inflammation of the rectum and its extent, since the stricture is a limited consequence only, not the essential disease; so that if we succeed only in removing the strictured part we have done nothing at all in the majority of cases, the inflammation being still there with all its actual symptoms and promise of a new stricture in the future. Consequently, the first question is to know how high the disease is extending in the rectum and possibly in the colon sigmoideum or even in other sections of the bowel. It is only in a few instances that this question is of little importance,—that is when we have to deal with strictures in the form of a ring or diaphragm secondary to a limited circular ulceration while the mucosa above it is practically healthy and not infiltrated. But generally the condition is that of a more or

less high-located and extensive tubular stricture with ulcerated mucosa above it and infiltration of all the walls of the gut and of the periproctal structures even where the mucous membrane appears healthy, and to such an extent in some cases as to reach the upper portion of the rectum, the sigmoid colon and the higher portion of the bowel. The infiltrated gut is thick and shortened, the ring-like lumen very much reduced, the surrounding fat fibrous, the mobility greatly diminished. In one case, even in the small intestine, near the cæcum, was an extensive infiltration and narrowing. We have to do in these instances not only with the stricture but with a proctitis, sigmoiditis, etc., so that the excision of the stricture cannot bring a permanent benefit. It is evident that applying a routine treatment to such a manifold variety of lesion cannot bring a good result. A ring-like stricture can be efficiently cut and dilated, a short tubular narrowing with limited infiltration can be kept open by a patient prolonged dilatation, but in many other cases these means are useless, even very dangerous. The possibility of checking the inflammation by means of an artificial anus, irrigating the diseased part through it, passing bougies, elastic tubes, etc., is to be admitted only exceptionally effective. In my experience the artificial anus has been followed by a steadily progressive narrowing of the inflamed gut which after a long period of disuse may become converted into a hard unyielding scar. I have completely abandoned all these procedures as a rule, and I have resorted, like many others, to the only radical treatment, an excision based on the principle of an exact knowledge of the extension of the disease. Because of the lack of such preliminary information we see that although excision has been for a long time frequently resorted to, the results have not been very satisfactory. If it were possible to group the reported operated cases according to the extent of the lesion, I believe we could easily find that in all in which a proctitis or proctosigmoiditis was existing the result was nil. Recurrence of the stricture, permanence of the discharge and of distressing symptoms is the usual consequence of such operations notwithstanding

they appeared very extensive and liberal at the moment. Certainly some recurrence may be due also to the technic employed, failure of suture, etc., but chiefly to the above discussed reasons.

I hope that for the efficiency of surgical treatment, surgeons will agree with me on this first principle, that is, the necessity of an exact preliminary knowledge of the extent of the disease. Clinically this is seldom possible. Symptoms and physical examination can sometimes make out this point, sometimes can induce a suspicion, almost never can exclude a high inflammatory involvement. Consequently follows the necessity of an exploratory laparotomy for examination of the intestine as a preliminary to the radical treatment. This may at first seem a too severe method of diagnosis; but if we consider its importance on one side, and if on the other side we agree on the absolute necessity of starting the treatment by the establishment of an artificial anus, my proposition will be accepted as a legitimate one.

The reasons for an artificial anus are obvious. The patients come to us in a very poor condition, emaciated, even cachectic, running sometimes a continuous fever or having intermittent attacks of it, with pain and distress at short intervals in accomplishing the imperfect bowel function. They need a long period of rest to be fit for a severe operation. Besides, the artificial anus is our best safety-valve, allowing aseptic operating and a clean after-treatment.

Where to establish the anus and the way of exploration will be briefly discussed. In some instances I have done it on the right, in others on the left side, always through a gridiron incision. This can be made, if needed, as large as is required for a clear examination of the abdomen, by cutting transversely the anterior rectus muscle sheath and pushing the muscle medially. If it has been made on the right side, so that a cæcostomy has to follow, the incision should be larger, it being more difficult to reach the colon sigmoideum and the rest of the colon. Palpation and inspection, drawing possibly the more movable parts into the wound, have to be used, and not

to be forgotten is the examination of the last loop of ileum where stricture can be present without having given peculiar symptoms. The cæcostomy has to be very large to assure a complete drainage of the colon, and for this purpose I draw into the wound the cæcum and the ascending colon. Often the small intestine invaginates later through the ileocæcal valve and protrudes from the cæcal wound, but this has no bad consequence and gives us the most effective and sure total drainage. On the left side the exploration of the sigmoid is easier, and has the advantage that in case of high infiltration of the cæcum and of colon we can cut the intestine near the upper limit of disease, suture and drop the distal portion, fixing the proximal to the skin, insuring the best function of the anus. The distal segment is ready for the future perineo-abdominal extirpation, the proximal for its mobilization and transplantation into the anus.

But if we do not find high involvement of the rectum, so that no abdominal operation is needed, then the left artificial anus has clearly the disadvantage of having established adhesions of the sigmoid and of having created an opening in a portion of gut which it may be has to be lowered down into the pelvis. For this reason I usually explore from the right side, establishing a cæcal colic large anus. The patient is treated for weeks and months with saline washing from the artificial anus and from the rectum with a thin soft tube, till the general conditions are good and the fever has disappeared.

The radical operation will now follow, and it will be guided by what the preliminary exploration has ascertained. If the lesion is a limited one we may perform a perineal extirpation; if extensive, we have to resort to a combined operation, in both cases the aim being to preserve the function of the sphincter and to put into it a healthy portion of bowel. For preserving the function the common practice in rectal surgery has been a resection of the bowel, leaving the anus intact and suturing the two ends together, or to insert the

proximal end through the anus after dissection of its mucosa, to the skin. I have abandoned these principles. Usually the anal portion, in our cases, is much deformed, the mucosa is infiltrated, rigid, adherent to the other layers; a circular suture is difficult and easily fails or has the tendency to contract later. The insertion of the proximal end through the anus is frequently difficult if the rectum has been removed low down in the limits of the ampulla, the size of this not corresponding exactly to that of the deformed anal portion,—and if the rectum has been removed high so that the sigmoid has to be pulled down after mobilization, there is no good room for the adaptation of the thick mesentery into the anal ring. In both cases a failure of the suture can happen with a certain consequent stricture. Besides, I have found that it was technically much more difficult for me to resect the rectum leaving intact the anal portion, as it is sometimes extremely difficult (in contrast with cases of cancer) to isolate the adjacent strictured rectum in its whole and then cut it and resect from below upward or vice versa, without disobeying the rules of asepsis.

I consider as the safest and easiest way that proposed by Witzel in 1906 for an aseptic removal of cancer of the rectum. The Kraske method or one of its modifications are not necessary at all; the vaginal route has the disadvantage of a possible very troublesome vaginorectal fistula.

I will sketch briefly the Witzel operation, being rarely adopted as far as my observation goes. The principle is to preserve the function of the sphincter and to perform an aseptic operation throughout till after closure of the external wound. I put the patient under novocain spinal analgesia, in an exaggerated lithotomy position, with the upper part of the body in Trendelenburg medium inclination, so as to have the abdomen ready to be opened in case of need. The sphincter is relaxed by the novocain so amply that the mucosa is easily accessible and can be exactly closed with one or two rows of fine stitches, not including the skin. Gloves are changed, the

region is disinfected again, and an incision is made in the median line posteriorly, from the anus to the middle of the sacrum, laying bare and excising the coccyx first, then going deeper, reaching the rectum posteriorly and dissecting it bluntly from the concavity of the sacrum to the promontory, and on the sides. In the upper part—that is, near the anus— the incision goes to the external sphincteric ring and divides it exactly in the median posterior line, avoiding carefully injury to the previously closed mucosa ani. As the extremities of the cut sphincter retract spontaneously, they allow a clear dissection of the mucosa ani from the muscular fibres all around and high up, till we reach and open on the sides the funnel-shaped fat space limited laterally by the levator ani, covered by the pelvic aponeurosis, and mesially by the rectal wall. In this space proceeds the blunt dissection laterally of the closed rectal tube, and as the cut and dissected sphincter in a horseshoe form can with its lateral nerve supply intact be widely retracted by instruments, we have ample room for an exact dissection of the vagina or of the prostate from the rectum, for reaching and cutting the Douglas pouch (in every case!), for dividing the adhesions, tying the singular vessels, till the rectum is made movable to the extent required to bring down a healthy portion of it, or, if necessary, of the sigmoid colon, without traction, to the skin level. The still unopened gut hangs out of the wound, and we first close the peritoneum on its front and sides; then we stitch loosely the sphincter to that healthy segment of the intestine which is in contact with it, taking care to approximate the divided muscular fibres. We close the external wound and drain it, and only now the bowel is sectioned at the level of the skin and its mucosa connected with sutures to it. In this way no contact of septic material with wound or hands is possible, the sphincter with its nerve supply is preserved; ample room is given for the operation. Should the intestine come under tension to the skin, Witzel advises to pull up the sphincter, putting a silver stitch on each side through the ischiosciatic ligament and the

skin in front of the sphincter; but in cases of stricture where the dissection is difficult and not always exact, if the intestine is under tension, the risk of checking the circulation is great, I prefer to stop the perineal operation, being fully persuaded that a further dissection and mobilization from this way is too irregular and dangerous for the circulation, and if possible, in the same day, open the abdomen, free the intestine, ligating the superior hæmorrhoidal artery and its sigmoid branch in the right way: that is, avoiding cutting or interfering with the arch anastomosis from which only the circulation is maintained. Should the patient not be fit for this amount of work, the intestine is attached provisorily high up near the sacrum, the wound plugged, and an abdominal operation performed later. The artificial anus guarantees full asepsis of the wound.

Whenever an high involvement of the intestine has been previously ascertained, the radical treatment has to start deliberately from the abdomen. Having cleaned the bowels with great care for some days, and having, immediately before the operation, exactly plugged and aseptically covered the artificial anus, under spinal analgesia a median incision is made to expose the sigmoid colon. Lifting it up we can soon decide the point at which the intestine has to be cut, and from here upwards begins its mobilization. With a long loose sigmoid, and not very extensive lesion of it, the mobilization can be done without cutting it transversely; but in opposite conditions the work is more easily performed by dividing the sigmoid at the upper limit of the disease, between ligatures, avoiding any soiling of the field, and infolding both ends with suture. The upper end is pulled out, the peritoneum of its meso is cut on both sides and the vessels exposed. First is the superior hæmorrhoidal artery, which has to be cut, taking care to put the ligatures above the point at which it receives the principal arch anastomosis from the sigmoid artery which is a branch of the hæmorrhoidal itself or of the arteria colica sinstra. If necessary, this too must be cut, and it can be done

without danger to the circulation, if the section of the mesentery keeps far from the arch anastomosis, since through this the circulation may be preserved even if the inferior mesenteric artery should be ligated. But this is not necessary, since it is only its branches radiating from a centre which keeps the intestine in a circular position, and as soon as they are cut the circle stretches into a straight line. If the arch anastomosis is injured the circulation stops, therefore especial care has to be devoted to that anastomosis between the hæmorrhoidal superior and the sigmoid branch, this being the less rich point in the whole system, as Sudeck and Archibald have demonstrated.

The bowel can in this way be stripped off the iliac and lumbar fossæ, as far as the splenic flexure. This section of intestine too can be made free if necessary as high as to pull down the transverse colon, by cutting its attachments (phrenocolic and splenic ligaments) or dividing adhesions. The mobilized bowel is wrapped up in a warm saline towel and the excision of the distal part is begun from above downwards in the usual way till level with the levator ani muscle, and cutting the peritoneum all around. At this point it is better to stop the abdominal work and start from the perineum, according to the technic already described, removing the whole diseased intestine. Now the mobilized colon is grasped from below with a long forceps by an assistant, who pulls it down and sutures it to the sphincter and to the skin, while the operator from above tries to close with peritoneum the denuded iliac and lumbar fossæ, and the bottom of the pelvis, and sutures the abdominal wall.

To perform comfortably this operation there is required a position of the patient such that the upper body being inclined as for laparotomy and lighted from above, the perineosacral region should be freely exposed to the light with legs slightly flexed and well abducted through articulated supports.

As far as I know this combined operation has never been performed before for strictures and, it may be, not deliberately

in this way even for cancer. I first performed it, not so technically complete, in 1903, and five times since in the last three years, with three deaths. This high mortality is surely a great drawback, and I will not legitimate the operation by saying that future improvements and familiarity with the technic will make it safer. I have only to observe that for many cases this operation is the only one possible, and, if successful, gives full guarantee for the future, which is not true even for the most extensive operation in case of cancer.

I have tried the operation three times in two stages. First, removing the rectum from the perineum and suturing the upper stump to the sacral wound, and secondly freeing the colon from the abdomen and bringing it down to the anus; but in these three death followed.

As to the function of the intestine, it cannot be expected to be at once perfect, on account of the many well-known changes in the innervation and muscular action which always follow a rectal extirpation, but I can state that the patients have been highly satisfied and their health completely changed. A small plastic operation aiming to a more exact union or apposition of the cut sphincter ends, and to a narrowing of the intestinal opening, can be later safely performed when the circulation of the implanted bowel cannot be imperiled any more.

In conclusion, I believe that in cases of stricturing proctitis or proctosigmoiditis the treatment is to be as follows:

1. Cæcal anus and laparotomic exploration of the bowels.

2. Perineal or combined removal of the diseased section, in one or two stages, with mobilization of sigmoid and colon if necessary, and preservation of sphincter.

3. Closure of cæcal anus.

4. Plastic operation, if necessary.

I wish to emphasize the importance of resorting more frequently to the abdominal route in the treatment of strictures of the rectum for the purpose of preliminary exploration, and the importance of exact ligating and cutting the arterial

supply from the abdomen, even in cases of perineal operation, to prevent any damage to the circulation.

LITERATURE.

References to the literature have purposely been avoided in this memoir, but I feel obliged to mention the following papers from which many technical suggestions have been derived.

Witzel, P.: In F. Wentzel, Rektum amputation nach Witzel, etc. Münch. med. Woch., 4 Sept., 1906, p. 1757.

Sudeck, P.: Ueber die Gefässversorgung des Mastodarms in Hinsicht auf die operative Gangiän. Münch. med. Woch., 1907, p. 1314.

Archibald, E.: Operative Treatment of Cancer of Rectum. Jour. Am. Med. Assoc., February 22, 1908, p. 573.

For consultation on the subject of mobilization of the colon, being only studies of the argument:

Moynihan, B. G. A.: The Surgical Treatment of Cancer of Sigmoid, etc. Surgery, Gynec. and Obst., May, 1908, p. 463.

Cavaillon (P.) et Chalier: La mobilisation en masse du colon gauche, etc. Lyon Chir., 1 Fevrier, 1909, p. 378.

THE OPERATIVE TREATMENT OF FRACTURES.*

BY W. ARBUTHNOT LANE, M.S., F.R.C.S.,

OF LONDON,

Surgeon to Guy's Hospital; Senior Surgeon to the Hospital for Sick Children.

I HOPE to put before you clearly and briefly my views of and experience in the treatment of simple fractures.

I was originally led to resort to operative procedures by finding, from the dissection of bodies whose bones had sustained fractures, that the fragments when displaced had hardly ever united in anything approaching accurate apposition, and that definite changes took place in those joints whose functions were affected by the alteration in the physiology of the skeleton resulting from such imperfect replacement of the broken fragments.

A careful inquiry into the results of the treatment of fractures by splints and manipulation confirmed the experiences of the dissecting room and showed that the consequent joint changes meant depreciation in physique and the wage-earning capacity of those who had to engage in laborious pursuits. These views met with violent opposition till the discovery of X-rays proved that the first contention was true, while the law courts are steadily impressing on the profession, in a costly manner, the disabilities which are associated with imperfect restoration in the form of broken bones.

In 1894 I read before the Clinical Society of London my first paper on the results of the treatment of simple fractures by operation, and I contrasted them with those obtained by other means. Since that time I have continued to operate on all simple fractures in which I was unable to bring the fragments into satisfactory opposition when the circumstances of the patient required it.

During the last seventeen years, I have operated upon a

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very large number of recent fractures at all ages, from early infancy to extreme old age, with the same uniform success. I have employed various methods at different times, endeavoring to devise means of fixation of the fragments in accurate apposition which shall be at the same time effectual and easy of application. I soon recognized that if the treatment by open operation was to become general it was necessary that the procedure should be rendered as uncomplicated as possible.

The difficulty that has beset this treatment is that, if a foreign body is left in a wound the surgeon must be infinitely more careful about asepsis than he is in the ordinary course of events and careful in a degree proportionate to the bulk of the foreign body. Judging from what I have read on the subject, it would also appear that the methods of the antiseptic surgeon, as contrasted with those of the surgeon who practices asepsis, are prejudicial to success. It is because of insufficient aseptic precautions and to some extent from a want of familiarity with the use of wire, screws, etc., that we hear so many complaints of the development of rarifying osteitis about a screw or wire perforating a bone, of screws working loose and consequently becoming ineffective for the purpose for which they were employed, and of the employment of such futile methods as ivory pegs, etc.

With the exercise of greater cleanliness and with an increasing manual dexterity these troubles will cease to arise. Why a surgeon should not be governed by the same principles by which an ordinary skilled mechanic works I cannot understand, but I presume that the surgeon has rarely had any such training as would fit him for this kind of work. Curiously enough, the opposition to such operative procedures which continued with such intensity for so long, seems to have suddenly diminished because several surgeons have broken loose from tradition and have satisfied themselves that by operation alone can the greatest measures of success be obtained.

I do not propose to discuss the various methods I have adopted for retaining the fragments immovably in accurate

apposition, but will confine myself to describing those which I now find most effective for the purpose.

The locality of the incision should be carefully chosen, to avoid damage to important structures and especially to nerves, and to reduce to a minimum the chance of subsequent infection of the wound. In the lower extremity there is no risk to important vessels, tendons or nerves, but in the arm the conditions are very different, and every precaution must be taken.

To ensure asepsis, which one can do with certainty, an incision of ample length is made. Several folds of gauze are attached to the edges of the skin incision by means of fenestrated forceps specially constructed for the purpose. They are long and heavy enough to fall away from the wound and do not require to be held.

The forceps used to control hemorrhage exert pressure upon the bleeding vessels sufficient to permanently obliterate their lumen. By their use the necessity of the introduction of the gloved hand into the wound for the purpose of tying a ligature is avoided. The danger of the rubber glove is the possible presence of a puncture through which infection might enter the wound. The hæmostatic forceps are very long, so that the handles fall free of the wound.

All instruments employed for manipulating fragments, holding swabs, plates and screws, for drilling bones and driving in screws are also very long and very powerful, in order to avoid any contact with the wound of the portion of the instrument grasped by the hand, since the gloves are liable to be damaged in the powerful manual efforts which are sometimes necessary to restore the broken bone to its original form.

In considering the means by which accurate apposition of fragments are effected, we must take into account the nature of the fracture and whether one or two bones are involved. Besides this, comminution often adds greatly to the difficulty of the operation.

In torsion fractures the surgeon must remember that in

proportion to the overlapping of the fragments so there exists between and separating the surfaces which have to be brought into apposition an increasing quantity of muscle, since the chisel-shaped fragments diverge from one another as they overlap, burying themselves in the surrounding soft parts.

Any one who is imbued with the old creed and unfamiliar with operations on recent fractures, would imagine that to effect apposition all that is necessary is to exert traction upon the distal fragment of the broken bone by pulling on the limb, the trunk being secured, and that by means of this traction the fragments can be drawn from their beds in the soft parts and the fractured surfaces placed in accurate contact.

In the case of spiral fractures of the long bones of the lower extremity, in which this variety of fractures is the most common, no amount of traction which can be exerted on the limb is sufficient to overcome the over-riding of the fragments. This is due to the resistance offered by the bruised and swollen soft parts which surround the fractured bone and from the point of view of traction on the limb form inextensible ties in its length. This applies equally to fractures produced by direct injury, the resistance to replacement varying with the extent of overlapping of the fragments, the amount of extravasation of blood, the laceration of soft parts and the consequent inflammation.

To effect apposition in spiral fractures it is necessary to divide or displace all soft parts intervening between the fragments, to carefully clean away any clot or soft tissues from the fractured surfaces and especially from the retreating angles of the fragments, and to exert traction on the limb, supplementing that traction by forcible apposition of the fragments by powerful forceps, which are so manipulated as to glide the inclined plane of one fragment upon the other. This gliding of the fragments is facilitated by the introduction of a narrow flat blade with a serrated edge to prevent it slipping between the fragments. This, when rotated upon its axis, by its powerful leverage action moves the fragments held together by the forceps upon one another.

In the case of a fracture of a single bone, as the femur, which has been broken by direct injury, the extent of the overlapping of the fragments is from the nature of the injury and the mode of causation of the fracture usually much less. Still, the damage sustained by the surrounding soft parts or ties in the length is correspondingly greater, since in the torsion fracture the injury which the muscles sustain results solely from the fracture, while in that produced by direct injury the soft parts are lacerated and bruised by the impact of the force which determined the fracture, and only to a small extent from the forcible displacement and overlapping of the fragments.

In a fracture of the femur produced by direct injury, traction alone exerted on the limb does not appear to influence the over-riding of the fragments. The fragments can most readily be brought into apposition by so manipulating the limb that the extremities of both are made to protrude through the incision and can be manipulated till the inner margins of the fractured surfaces are brought in contact with one another. Each fragment is grasped with forceps, and while the limb is slowly and steadily extended the opposing edges of the ends of the fragments are levered on one another till the broken surfaces come into accurate apposition, when the axes of the fragments are in continuity and the bone is restored to its normal form.

This difficulty does not exist to the same extent in fractures of the upper extremity produced by direct injury, since the ties in this limb are less bulky and tense than in the leg, and, from the nature of things, spiral or torsion fractures are of comparatively rare occurrence in the humerus, radius or ulna, though they are not infrequent in the metacarpals.

The difficulty of effecting accurate apposition is very greatly increased by the presence of comminution, which can make a considerable demand on the skill and ingenuity of the surgeon. This complication produces most obstacles in the case of the spiral fractures, since every aspect of the fragments is very oblique and much is necessarily out of sight and

there is no surface or point on which one fragment may be made to pivot or impact on the other.

Perhaps the most awkward complication one may have to meet is great fragility of the fragments, such as appears to exist to a great extent in alcoholics and to a lesser degree in feeble children and in old age. But this concerns the retention of the fragments in apposition rather than their reduction.

Delay in operating renders the replacement of the fragments more difficult because the shortened soft parts or ties become rapidly less extensible and a correspondingly greater force is required to stretch them. This is a serious matter if the bones are fragile or comminuted. The operation should be undertaken as soon as the skin can be effectually cleansed.

As to the best means of retaining fragments securely in apposition when the fractured bone has been restored to its normal form, I would point out that in certain fractures, as in those about epiphyseal lines, there is usually no tendency to a recurrence of the displacement once reduction has been effected, providing the part is put up in a position the reverse of that in which it was produced. For instance, in a Colles' fracture either through bone or through the junction of the shaft with the epiphyseal line, after replacement of the fragment by manipulation or operation the hand is retained in a position of extreme flexion and adduction, which is also the extreme position of usefulness. It is well to remember that if the surgeon has to employ any means for retaining an epiphysis in position, as, for example, in separation of the lower epiphysis of the femur, he should insist on the removal of the rigid connecting medium after union has been effected, otherwise it will control the growth in the epiphysial line and deformity will result. In a case of a complicated fracture through the inner half of the epiphyseal line of the lower end of the femur, objection was made to the removal of the staples which were employed to retain the fragment in position, because of the condition of the patient. Later this patient developed a bowed leg.

There are occasions on which it is necessary to rely on

screws alone, as in the case of fractures of the neck of the femur and in some spiral fractures, but in the vast majority of cases I prefer to use as long and as strong a steel plate as possible, carrying as many screws as space permits. To reduce the difficulty of finding the drill hole in the distal compact layer of bone, which is frequently of no avail when the fragment is comminuted, I employ screws of a length only sufficient to engage the proximal compact tissue and threaded up to the head in order to secure as firm a hold as possible on the bone. For this purpose I use screws in two lengths— $\frac{1}{2}$ and $\frac{5}{8}$ inch, and in two gauges, Nos. 5 and 7. In the young infant I employ $\frac{3}{8}$ and $\frac{1}{2}$ inch screws in No. 3 gauge.

The fewer the varieties of screws employed the smaller is the number of drills and consequently the less complicated the operation, since each gauge of these modified screws requires only one drill. By this means I have reduced enormously the difficulties of securing the fragments immovably in apposition. In simple fractures I hardly ever use wire. I would exclude from this the fractures of infancy when two or more weeks have been allowed to elapse between the receipt of the injury and the operation. In such cases the distal fragment loses its density at a very early period, and while the proximal fragment will hold the screw securely, the thread will get no secure grip of the distal portion because of its friability. In these circumstances I supplement the junction by encircling the plate and distal fragment with a loop of silver wire.

The operative measures which are required in the treatment of badly united fractures are similar except that the fragments have to be cut through in two distinct planes in fracture of a single bone and in four planes in fracture of two bones such as the radius and ulna or tibia and fibula, in order that the axes of the fragments can be rendered continuous. These operations are very much more difficult and are accompanied with more risk from hemorrhage than are recent fractures. The results obtained are also very rarely as good, because of the changes which develop in the joints whose

functions have been affected by the faulty junction. I think that with better initial treatment such cases will soon cease to exist.

Whatever the extent of the shortening in badly united fractures, the surgeon should endeavor to correct it entirely or to reduce it as much as possible. There is, as far as I am aware, no limit to which the muscles, nerves, vessels, etc., can be stretched if only sufficient force can be exerted on the fragments. Such operations may make a very great demand on the skill and resources of the surgeon, and an increasing familiarity with them will enable him to obtain an increased measure of success.

A CLAMP FOR THE FIXATION OF UNUNITED FRACTURES.

By RUTHERFORD MORISON, M.B., F.R.C.S.,

OF NEWCASTLE-ON-TYNE,

Senior Surgeon, Royal Victoria Infirmary; Lecturer on Surgery and Operative Surgery, University of Durham College of Medicine.

BECAUSE it had always appeared to me unsurgical to leave permanently buried in the tissues anything indestructible for a considerable time, I was on the outlook for some appliance which would hold together fractured bones till union had occurred, and which was then removable. The case of a young man whose femur had been wired with success five years previously, strengthened my desire, for his femur refractured at the site of union while he was walking in the street, and exploration showed that the bone had become so softened for some distance around the wire as to allow of this. The softened bone could be cut with a knife.

My late house surgeon, Mr. R. J. Willan, took up the matter with enthusiasm, and to his ingenuity I am indebted for a clamp which has served me so well that I think it should be better known.

Description of Clamp.—The clamp is made up of two halves which are fixed together by a detachable joint. Each half consists of an oblong rim of thick tough steel with rounded corners, and with its surfaces flattened from side to side, the whole being slightly convex on its outer side and concave on its innermost side. From the middle of one long side of the oblong, and welded to it, projects the handle of the instrument, also made of steel, and one inch above the junction of the handle with the oblong portion is the site of the joint between the two halves of the clamp. Upon the inner surface of the portion of the rim opposite to where the handle is attached, five steel teeth are firmly fixed. The three central teeth project inwards three-sixteenths of an inch; they are half an inch broad and are wedge-shaped on section; the remaining teeth are conical and also project three-

1114

FIG. 1
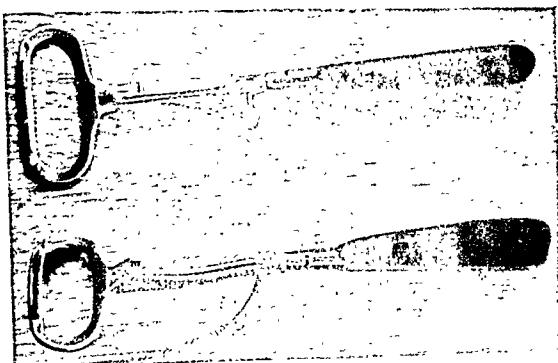
Clamp with blades separated.

FIG. 2
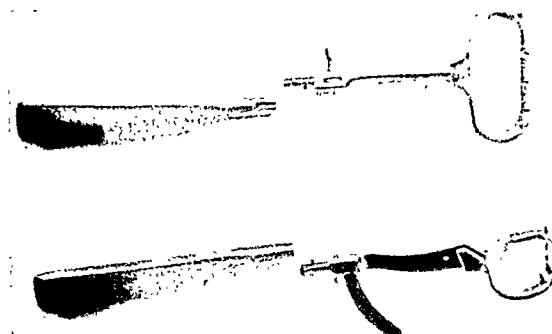
Four separate portions of clamp.

FIG. 3
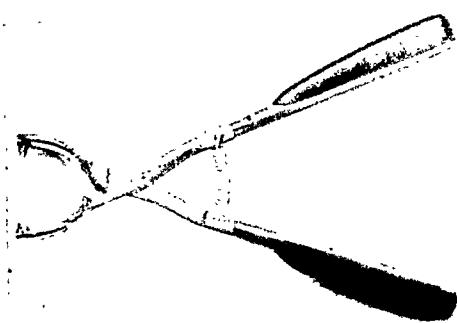
Clamp ready for use.

sixteenths of an inch. The free edges of these teeth are sufficiently sharp to grip firmly the surface of a bone when the clamp is applied. The handles are 3¼ inches long, and are made so that detachable handles of equal length can be affixed, a greater purchase thus being obtained in the clamping of the bone at the operation. The mechanism for screwing the clamp, when it has successfully grasped the bone ends, is a ratchet with a set screw. The size of the oblong portion varies according to the bone to be clamped; the teeth and handles (fixed and detachable portions) are the same in all. The two halves of the instrument are united by a joint which is detachable in order to facilitate removal.

Operation.—The technic of the operation was the same in each of the following cases. The bone ends were exposed through an incision parallel to the long axis of the bone. The fractured ends were refreshed previous to their being manœuvered into position for the application of the clamp. In an ordinary case the operation can be quickly performed. It is necessary to follow certain rules in the application of the instrument. Of the five opposing pairs of teeth, two pairs must grasp the lower fragment, two pairs the upper fragment, and the remaining pair will be in the neighborhood of the site of fracture. Moreover, the teeth must grasp the bone about half way between its anterior and posterior aspects. If the clamp has been properly applied, the fragments are quite firmly held together. The detachable handles are then removed and the wound sutured excepting for the point of exit of the fixed portion of the handles. An ordinary dressing followed by many layers of sublimated wood wool covers the wound and buries the clamp, and the overlying bandages are starched. A supporting splint is then applied to the limb and the dressing is not disturbed till the clamp requires removal (in from 6 to 8 weeks). For this purpose it is necessary to give an anæsthetic, and partially open the wound, when the clamp can be rocked out by means of the handles. The second wound has always healed in the course of a few days.

CASE I.—T. D., aged 51, a coal miner. Twenty-seven weeks before admission to the Royal Victoria Infirmary, Newcastle-on-

Tyne, patient was struck on the right arm by the iron socket of a broken haulage rope, fracturing his humerus. His arm was kept on an internal angular splint, with a short splint at the site of the fracture, for eight weeks. As there was non-union at the end of this time the bone ends were wired together by an open operation at another hospital, and a splint was in addition applied for nine weeks. Upon admission on October 19, 1907, there was an ununited fracture of his right humerus at its middle. The clamp was applied and *left* on for nearly three months, when it was removed. This man has an arm so strong and useful that he is now following his employment as a coal-hewer.

CASE II.—N. H., aged 57, a coal miner, was admitted in January, 1908, with an ununited fracture of the middle of his right femur. He had broken the bone ten months previously by a miskick at a football. He was treated by the application of a long Liston splint and extension for three months; but there was no union. He had used crutches ever since for locomotion. Upon admission there was marked deformity of the limb, with an ununited fracture of the middle of the femur, movement between the fragments being very free. There was shortening of the leg to the extent of 3½ inches. The clamp was applied for eight weeks and then removed in the usual way. The man is now in full work as a coal-hewer.

CASE III.—J. W., aged 24, a motorman, was admitted in March, 1908, for disability of his right arm. He gave a history of having broken his arm three and one-half years previously owing to backfire of the motor. It was treated with splints for nine weeks. There was an ununited fracture of the ulna at the junction of its middle and lower fourth. The clamp was applied and left on for twenty-eight days, when it was removed. The bone was united. This patient's wage-earning power is now equal to what it was prior to the accident.

CASE IV.—W. P., aged 43, a coal miner. Eight months before admission, while at work in the mine, a fall of stone fractured his right femur. The treatment employed was immobilization by a long Liston splint, together with extension, for six weeks. This was followed by the application of plaster of Paris, which was kept on for a further eight weeks. At the end of this time, as there was still no union, the long Liston and extension treatment was resumed and continued for a further

six weeks without any union resulting. Upon admission, in October, 1908, there was an ununited fracture of his right femur at the junction of the middle and lower thirds, with deformity, marked loss of function, and great shortening. The bone ends were clamped in good position and at the end of two months the instrument was removed, there being perfect union. The patient is now doing his ordinary full day's work as a coal-hewer.

CASE V.—H. D. H., aged 28, a coal miner. Fourteen weeks before he came into hospital his right arm was run over by a tub, and both bones were fractured. The arm was splinted for six weeks in a semi-prone position, after which time massage and passive movement were employed. On admission he was a strong, healthy man. There was an ununited fracture of the right ulna, about the junction of the upper and middle thirds, and at the site of the fracture there was a false joint. Both supination and pronation were limited. The clamp was applied on January 2, 1909, and it was removed six weeks later, when there was firm osseous union. He has returned to work with a useful arm.

the humerus and occurs chiefly in fractures of the middle third of the bone; less frequently it occurs in fracture of the lower third, and rarest of all it occurs in fracture of the upper third of the humerus.

The general subject of paralysis of the musculospiral nerve will be alluded to only as it is helpful to a more satisfactory knowledge of the nerve lesion in connection with fracture of the humerus. The paralysis of this nerve associated with fracture differs from other paralyses of this nerve chiefly in etiology. The symptomatology and indications for treatment may present identical problems. It is possible to have a musculospiral paralysis in a case of fracture of the humerus from causes entirely independent of the fracture.

Moreover, the fracture of the humerus is not the only bone fracture which may damage the musculospiral nerve: ulnar fracture in the upper third has been attended with symptoms pointing to involvement of the posterior interosseous nerve.

Anatomical.—The musculospiral nerve pursues its course through the upper arm in close relation to a solid structure—the humerus—and maintains its closest relation with the bone and periosteum in its middle third. The nerve is not imbedded in soft tissues. Moreover its course is spiral, thus subjecting itself peculiarly to traumata resulting from displacement of fragments. The chances of injury to the nerve by tension or pressure, though lessened in some degree on account of the nerve running in a bony groove, are increased by this anatomical arrangement in case fracture and displacement occur. Especially is this true if the nerve is held firmly to its groove by natural tissues or overlying muscle. These features of the anatomy are most potent causes for occurrence of a pathological rarity—a nerve caught between the fractured surfaces of a bone.

Before the nerve enters the groove or just about at that point, it gives off three cutaneous branches which are described as supplying the upper arm: these branches run more in the muscle tissue and preserve their function in the large majority of traumatic paralyses of the musculospiral.

In attempting to explain the integrity of musculospiral sensation so frequent in fracture with motor loss in this nerve, Fessler has been led to believe the sensory supply to the radial half of the dorsum of the hand leaves the nerve above the fracture and escapes functional impairment by its course in soft tissue.

This anatomy of the sensory supply can hardly be accepted as final. Several authors have been puzzled to explain lack of sensory loss on an anatomical basis. Goldstein suggested that the ulnar nerve carried the sensory fibres; others thought there existed a sensory supply of the radial distribution through other routes.

Primary and Secondary Paralysis.—In separating cases of musculospiral paralysis associated with fracture of the humerus into classes Riethus has been chiefly followed. He made two broad divisions based on the time when symptoms of nerve involvement appear. Thus they are (1) immediate or primary, and (2) secondary.

A further subdivision of the primary cases is made by Goldstein into (*a*) the nerve is damaged by the injury, (*b*) the nerve is damaged by the bone.

The symptoms of nerve impairment appear immediately in the primary cases and stress is laid on the importance of examining every fractured humerus with reference to neural integrity. Many times after the recognition of paralysis of the musculospiral nerve, uncertainty of its duration has had to be admitted by the attending surgeon.

The secondary cases are those in which musculospiral paralysis develops from nerve compression or stretching during the course of osseous repair. Fessler further divides the secondary cases into (*a*) those occurring during the healing process, and (*b*) those subsequent to fracture healing; in the latter variety necrosed bone, a pseudo-arthrosis, or a fistulous tract may be the cause.

Musculospiral nerve injury may complicate fracture of the humerus at any age and has been known to occur with obstetrical fracture; infants and adolescents present numerous

examples of paralysis (Broca and Mouchet). In these cases at early ages no special point of fracture is found responsible for musculospiral paralysis.

Etiology.—The principal factor in the etiology is the anatomical relation of the musculospiral nerve to the humerus, especially in the middle third of the bone.

In the primary cases coincident with or immediately following the fracture, the nerve may be contused, stretched, divided partially or completely, pinched between the fractured ends, or be impaled by a splinter. Goldstein believes generally there is complete rupture of the nerve at the time of the break and in 20 primary cases found complete division in 12. In 13 cases of children Vennat reports 3 cases of complete division; Bruns found that about 8 per cent. of paralyses were due to partial or complete tearing of the musculospiral nerve. Riethus in 8 cases of primary paralysis found the nerve divided in 3 instances.

The secondary cases are comprised largely in one class, namely, callus inclusion * of the musculospiral nerve which by pressure, as is generally assumed, impairs the function of the nerve till even total paralysis is developed; or if the callus gives a free tunnel for the nerve it undergoes stretching to a degree that suspends more or less completely its functions. Even if the nerve is not included in the callus tissue but is pushed before it, the course of the nerve over the rounded mass may result in a stretching with loss of function.

In 55 cases Blenke reports 35 secondary cases, or 63.6 per cent. This may perhaps be accepted as approximately the proportion of secondary cases.

Symptoms.—The symptoms of musculospiral involvement at the time of fracture or during repair are largely of motor impairment or loss. The forearm extensor muscles controlling the wrist and digits lose either partially or completely their power; and some degree of anæsthesia may be established in the radial nerve supply. Chiefly the sensory loss is found on

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* Savariand believes contusion of the nerve is the most frequent cause of paralysis and that it is spoken of least.

the dorsum of the hand between the metacarpal bones of the thumb and forefinger, the so-called "punctum maximum" of anæsthesia. It is remarkable to what a degree sensation is retained; Fessler's views of the anatomy have already been referred to by which he explains this integrity of sensation: he attributes it to the more superficial course of the cutaneous branches which leave the trunk of the nerve above the fracture and carry, as he believes, sensation to the radial half of the dorsum of the hand. On the basis of this anatomy Fessler further asserts that immediate sensory loss from tearing of the nerve indicates that the fracture is above the middle of the humerus.

In general the sensory symptoms have no relation to the degree of motor loss. It is said that sensory disturbance follows primary paralysis only and that secondary paralysis has no sensory disturbance (Fessler).

The symptoms are largely motor; the muscles paralyzed are: extensor ossis metacarpi pollicis, extensor communis digitorum, extensor carpi radialis, extensor carpi ulnaris, extensor longus pollicis, extensor brevis pollicis, extensor indicis, extensor minimi digiti, and supinator longus and brevis.

The position assumed by the arm and hand in musculospiral paralysis is flexion of the fingers at the metacarpophalangeal joints with ulnar abduction and slight flexion of the wrist; the thumb is adducted and the forearm pronated.

In primary paralysis or paresis the onset is as sudden as the break of the bone. The secondary cases may develop insidiously with formications and sharp pains along the nerve and functional failure by degrees along with the compression.

No definite time can be set when the callus interferes with nerve function, but in a general way it is in the second week or later. It is important to ascertain whether a period of preservation of function of the nerve immediately follows the fracture. The motor and sensory disturbances set in practically simultaneously in secondary cases (Riethus).

Trophic disturbances are rare but atrophy may occur and

in exceptional cases the nails, skin, and cellular tissue may show nutritional deterioration.

Callus incarceration of the musculospiral with total paralysis may be attended with neuralgic pain especially on movement. Bruns, however, says irritation and paralytic symptoms may be wanting with the nerve incarcerated.

From callus irritation the perineurium may proliferate in a spindle-like thickening, forming a sort of neuroma. On the other hand the nerve may be flattened and thinned (Blenke).

Prognosis.—The prognosis in a general way is favorable to recovery in the large majority of cases which have had the benefit of operative procedure. According to Bruns 50 per cent. of all cases require operation. Murray claims that in 37 cases he freed the nerve 34 times without suturing, and in 3 cases he sutured the nerve, with almost uniform restoration of function. Kramer believes the prognosis is good; he had 35 cases with only 3 bad results. Blenke had 41 cases of perfect healing, 6 cases almost perfect, 8 cases with considerable improvement and 3 cases showing little improvement. One case with unfavorable result presented a divided nerve with ends lost in the callus at the time of operation, 6 weeks after fracture. Blenke believed success would have been attained if operation had been resorted to earlier. In other cases he believed the interval before operation too long.

Some cases have been operated on a second and a third time. There exist records of cases operated on 16 months, and 3½ years after fracture with restoration of nerve function. In general the longer the duration of paralysis the less favorable the prognosis.

The time of improvement after operation varies from a few weeks or even days, to months; generally it begins in 3 to 4 months and final cure is completed in about a year's time. One case (Riethus) with resection of the humerus recovered in 2 years, improvement setting in first after one year.

Cases are recorded of quick return of sensation in one

day, in 2 days, and 8 to 10 days after operation. The general law seems to hold true for the musculospiral that sensation returns before motion after paralysis of both.

Electrical reactions in some measure are of prognostic aid, but their value is limited because they cannot indicate the pathological condition. A complete reaction of degeneration is more unfavorable than a partial one, and though it would make the prognosis grave is by no means a contraindication to operation. But a change in the character of the reaction of degeneration is perhaps of most significance, being unfavorable when the negative current response of the muscle is less than the positive. Most favorable is the presence of Faradic response in the nerve, which however is usually subsequent to evidence of voluntary return.

Indications for operation.—What are the indications for operation in musculospiral paralysis complicating fracture of the humerus and its healing? Every case of paralysis, whether primary or secondary, requires careful study as to the question of operation. The pathological condition of the nerve is the vital point and, unfortunately, similar symptoms may attend a varied pathological condition; there is not even a pathognomonic symptom of complete division of the nerve.

Of more importance than the fact of some failure of function in the musculospiral is the time it has persisted and whether it is getting less or increasing. Many cases have recovered without operation; Bidder has two cases cured without operation; 8 out of 17 of Riethus' cases got well without operation. Many other cases are reported in which exploration was unnecessary. On the basis of the foregoing, Blenke says operation is not immediately necessary but a case should be handled expectantly; if primary paresis persists and increases then operate. Von Bruns states that if 4 to 6 months pass without improvement operation should be resorted to. Riethus asserts that secondary paralyses never recover spontaneously, so that operation is always indicated in this class of case. Moreover, it should be done early, though late interference has proved beneficial. Schreiber states that a case

of primary paralysis should not be operated if the symptoms are not increasing. A case of Ollier's is referred to in which by manipulation of the bony fragments (extension and circumduction) he is said to have freed the nerve.

The Röntgen ray has been of great service. First of all it demonstrates the position of the bones. Good alignment would assure the surgeon that the nerve was not on a stretch continuously. A large shadow of callus would be of corroborative value in secondary cases. The information as to the nerve is indirect, for after all we have to infer what may have happened to the nerve from what is found as to the condition and position of the bone.

The results of electrical findings are of some aid in demonstrating the degree of paralysis present, and may be of the greatest help in determining functional restoration or impairment. But the pathological condition and the pathological future of the nerve are the essentials to be determined as nearly as possible; and the knowledge of the electrical reactions helps only a little. A contusion cannot be distinguished by the electrical reactions from damage due to callus or even a complete division of the nerve.

Vennat, however, believes that electrical reaction of the affected parts determines treatment: if a partial degenerative reaction persists, or the reaction is good, no operation should be attempted; but if there is complete reaction of degeneration operation is indicated.

Treatment.—In the treatment of these cases the question of operation requires conservative consideration. If a given case is going to get well with treatment other than resection, suture, or operative release of the nerve, operative interference is not required. On the other hand if permanent paralysis of the extensors is inevitable unless the musculospiral nerve is dealt with surgically, operative procedure is demanded. But such definite knowledge is not attainable in every case In the consideration of individual cases we should approximate as nearly as possible this ideal attitude before rendering an opinion as to operation.

A careful operation, even if unnecessary, would not interfere materially with ultimate recovery, while an error in failing to operate would be most regrettable. So it seems advisable on the whole to favor surgical investigation in cases in which doubt exists.

The time of operation is to be chosen at as early a date after symptoms of paralysis appear as possible. The later degenerative changes in both nerve and muscle are thus reduced to a minimum; and the progress of a partial, but increasing, paralysis may be arrested.

Indications for or against operative procedure turn after all on the pathological diagnosis. The more severe the trauma the greater the probability of some tearing through the nerve or even complete division, especially if there has been much rotation of the peripheral fragment, or it has been for a moment pulled apart from the proximal fragment, or the two fragments have been displaced out of line or at an angle; and in such a position the nerve on the stretch may be worn through by an edge of bone (Czerny). Such conditions, as well as that of being caught between the fractured surfaces and transfixion by a splinter of bone, are among the rarer complications pathologically; but if they exist, operation is imperatively required at an early stage.

If in primary paralysis of the musculospiral attending fracture of the humerus the anatomical continuity of the nerve is assured, nature can be relied on to restore function provided that the tension on the nerve is not abnormal and compression by new tissue is not superimposed in the process of repair. Good and gentle adjustment of the bony fragments largely insures against the nerve being kept on the stretch continuously. The complication of callus compression cannot be specially guarded against. If partial recovery of a primary paralysis is followed by a recurrence of the paralysis during callus formation we should then have to turn our attention to the consideration of it as a case of secondary paralysis.

Secondary paralyses of the musculospiral embrace the larger number of cases. A partial and moderate paralysis not increasing and with a partial reaction of degeneration offers the best chance for restoration of the nerve without operation. Again, if a stage of improvement sets in it would be wise not to interfere surgically but try to cause absorption of the callus and cicatrix by massage and electricity so as to free the nerve (Neugebauer).

Increasing paralysis, however, especially if it becomes complete, justifies surgical exploration—or rather demands it. Moreover, a condition of paralysis that is stationary would indicate operation.

In primary cases a divided nerve is to be sutured; if any condition is found that keeps the nerve on a stretch, readjustment of the bone fragments is indicated; if the nerve is caught between bony surfaces * it is to be made free; and impaling splinters should be removed. Resection of the humerus may be necessary to approximate nerve ends; but Blenke condemns the method of Hoffa—an oblique osteotomy —as two points are thus presented at which callus may injure the nerve. Ollier separated the periosteum to avoid new callus in one case. In all cases a proper bed for the nerve must be provided.

The secondary cases have received more attention by ingenious operators in their efforts to prevent repetition of compression. In most cases a clear channel is, to be sure, made for the nerve by simply removing compressing tissue. Latterly, however, the nerve has been further safeguarded by adjusting soft tissues, muscle, fat, or fasciæ about the nerve in such a way as to render impossible recurrent callus enclosure and pressure.

Just what the detailed operative procedure in both primary and secondary paralyses will be cannot be determined beforehand unless the operator obtains an accurate conception of the pathological conditions.

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* Pseudarthrosis due to retention of the nerve between the fractured ends of the bone has been observed by Blenke.

FIG. 1.
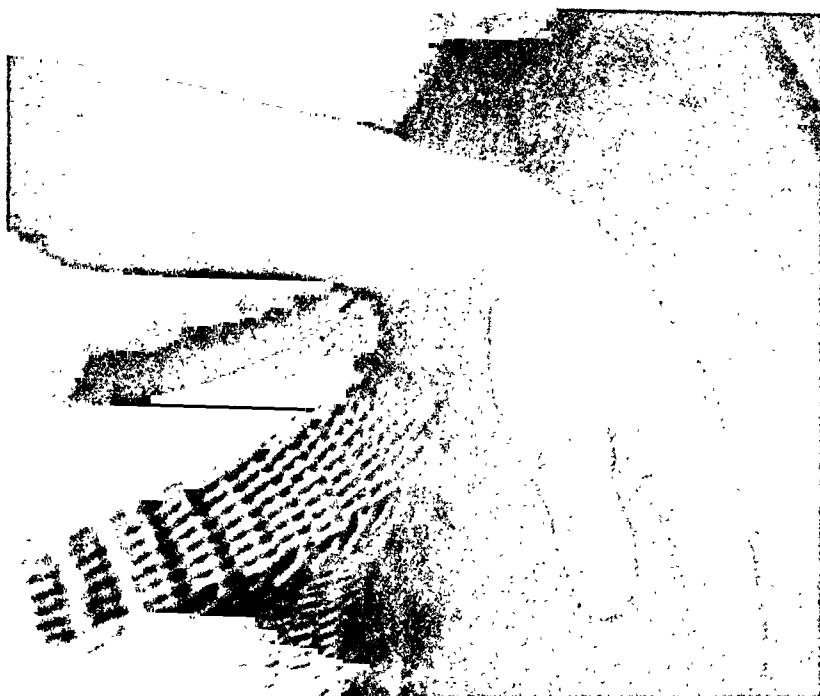
Case II.—Nine years after suture of musculospiral nerve. Note hand drooping from and muscles relaxed. (Case of Dr. M. H. Richardson.)

FIG. 2.

Case II.—Nine years after suture of nerve. Note extension of muscles in extending the wrist. (Case of Dr. M. H. Richardson.)

FIG. 3.

Case IV.—One year after suture of musculospiral nerve. Note relaxed position of hand.

FIG. 4.

Case IV.—One year after suture of the musculospiral nerve. Note powerful extension of wrist. (Case of Dr. H. H. A. Beach.)

Fig. 5.

Case IV.—Note the situation of cicatrix l e t [illegible] m [illegible] r d [illegible]

Fig. 6

Case VII.—Note ununited b[illegible]
contraction. When mu[illegible] [illegible]
still present.

FIG 7.

Case IX —Note left wrist-drop sixteen years after accident. Note atrophy of forearm and hand muscles.

Fig. 8.

Case IX —Note atrophy of shoulder and upper arm muscles

TABLE I.

No. Age, Sex.	M.G.H. No.	Date and kind of injury.	Nerve injury, when and by what.	Part of nerve affected.	Name of Surgeon.	Date of operation.	Result and condition of muscles.	Remarks.
1. Male 49yrs.	V. 600 P. 16	May 1, 1891. Arm caught in middle in belt or engine.	Discovered May 20, 1891. Divided by bone.	Rupture.	F. J. Bixter.	September 21, 1891. Nerve found divided, followed by fibrous band. Ends freshened and sutured.	No wrist-drop at 3 months. Slight loss of extension.	
2. Male 35yrs.	V. 650 P. 231	December 16, 1896. Rupture	Rupture.		M. H. Richardson.	May 21, 1897. Nerve found divided. Ends freshened and sutured.	Nerve anastomosis. Doubtful result. Died.	X ray showed shaft of humerus about the injury.
3. Male 35yrs.	V. 451 P. 227	Jan., 1901. Fracture.	Discovered February 16, 1896. Callus.	M. H. Richardson.	April 7, 1896. Nerve found involved in callus. Resected and sutured.	Five years later. Mechanical extension. Partly recovered. March 16, 1901.	
4. Male 18yrs.	V. 122 P. 291	Oct.11,'95. Pierced by gunshot.	Scar tissue. One shot in nerve sheath.	J. H. A. from electrical theme, cut across. Sutured.	January 18, 1896. Nerve freed from electrical theme. Nearly cut across.	One year later. No pain; no wrist-drop; no limitation of motion of arm. O. K.	
5. Male 29yrs.	V. 274 P. 125	Aug. 5, 1897. Mult. fractures.	Callus and scar tissue	M. H. Richardson.	1st operation, July 1900. Nerve freed from adhesions. 2d operation, Aug., 1900. Ulnar and median nerves freed from callus.	Six years later. Hand and arm motion O. K. Wrist and arm movements about one-half normal. Little and 5th fingers partly stiff. Median nerve normal.	
6. Male 33yrs.	V. 531 P. 41	April, 1900. Comminuted fracture, middle lower third.	Discovered at July, 1901. Nerve separated some distance and much atrophied. Freshened and sutured.	Ulnar nerve slightly impaired. No improvement. Died October 24, 1901.			
7. Male 33yrs.	V. 564 P. 189	July, 1893. Fracture, middle lower third.	Discovered after union. Bone divided by bone.	February 7, 1895. Nerves freed from callus and sutured.	Humerus ununited. Some atrophy of arm muscles. Marked wrist-drop.		
8. Female 25yrs.	V. 626 P. 111	November 27, 1905. Fracture at mid-dle.	Immediately noted. Bone and callus.	E. A. Codman.	December 16, 1905. Nerve dissected free and sutured.	Perfect functional result. Slight hyperesthesia. Lacks of thumb and second finger. Slight bowing at site of fracture. Dec. 5, 1906.	
9. Male 16yrs.	V. 334 P. 293	Oct., 1890. Comminuted fracture. (Caught in belt.)	Callus			1st operation, Feb. 21, 1891. Nerve resected and sutured. 2d operation, idem bone section. Nerve found bulbous at suture line.	Union good. Poor functional result. Wrist-drop complete. No elbow flexion.	
10. Male 25yrs.	V. 257 P. 22	Nov., 1889. Fracture; machinery crush.	Immediately noted. Bone and callus	J. Homans.	June 3, 1890. Nerve freed from callus	Some increase of motion in hand. Abduction of thumb. Complete extension of wrist. Dec., 1906.		
11. Male 6yrs.	V. 34 P. 82	March 2, 1899. Fracture. Much comminuted. Middle third.	Discovered April 24, 1899. Callus.	S. J. Mixter.	April 27, 1899. Nerve freed from callus. Resected and sutured.	Makes all motions except extension of thumb. 1 year 7 months after operation. Nov. 22, 1900.	

In an analysis of the Massachusetts General Hospital cases the following facts are of importance.

There is a total of 11 cases in which the end results are known. The important facts in these cases are tabulated in Table I. In Table II are placed the same cases showing the time that elapsed between the date of operation and the accident and between the date of operation and the last observation of the patient together with the functional result recorded at the last examination.

TABLE II.

Cases of musculospiral paralysis, Massachusetts General Hospital Clinic. Tabulated according to time elapsed.

No.	Date of accident.	Date of operation.	Interval between accident and operation.	Result and date of last observation.	Interval between oper. and final observ.
1	May 1, 1901 ...	September 21, 1901	4½ mos.	Sept., 1902. No wrist-drop. Improving.	1 year
2	Dec. 16, 1896..	May 22, 1897	5 mos.	December, 1906. Excellent result.....	9 years
3	January, 1903	April 7, 1903	3 mos.	March, 1908. Perfect result.	5 years
4	Oct. 11, 1905 ..	January 18, 1906..	3 mos.	January, 1907. Perfect result........	1 year
5	August 5, 1897	(1) July, 1900 ..... (2) August, 1900 .. (3) July, 1901	3 years	1907. Good functional result. Movements about half normal.	7 years
6	April, 1900	July, 1900	3 mos.	October, 1903. No improvement.	3 years
7	July, 1893.....	Dec., 1893, bone .. Feb., 1895, nerve Feb., 1899. bone Feb., 1907, bone	1 year, 7 mos.	February, 1907. Marked wrist-drop...	12 yrs.
8	Nov. 27, 1905..	December 16, 1905	3 weeks	Dec., 1906. Perfect functional result.	1 year
9	October, 1890 .	February 21, 1891	4 mos.	April, 1907. Wrist-drop complete.....	16 yrs.
10	Nov., 1889	June, 1890	7 mos.	December, 1906. Fair result. Extension of wrist possible.	16 yrs.
11	March 2, 1899	April 27, 1899	3 weeks	November 22, 1900. Perfect result, except extension of thumb.	1 year, 7 mos.

Eight cases of the 11 have no wrist drop at present. Three cases showed no improvement in the nerve function following operative interference.

Of these 3 cases, 1 died three years following suture of the nerve, showing no improvement in the nerve function; another (see photograph of Case VII, Figure 6) has had three unsuccessful operations for ununited fracture of the humerus at intervals of six to eight years; the third case had

at the first operation the nerve freed, resected and sutured, and at the second operation the bone shortened by resection, the nerve, found bulbous, resected and sutured. After 16 years there is no return of function in the nerve.

Eight of these cases were badly injured. The trauma was very severe; the arm was caught in the shafting or the belt of an engine, or had received a gunshot wound, or was crushed by machinery. Most all the cases were operated upon some three or four months following the accident. The longest interval between accident and operation was three years. This case recovered functional usefulness and the musculospiral supply. Improvement in these cases was first noted six months to one year following the operation.

SUMMARY.

1. Musculospiral paralysis occurs in from 4 to 8 per cent. of cases of fracture of the humerus.

2. Fracture of the middle third of the humerus is the fracture most commonly complicated by musculospiral paralysis.

3. Fracture of the humerus at any age may be associated with musculospiral paralysis.

4. Musculospiral paralysis is primary if it dates from the accident and it is secondary if it is subsequent to the accident.

5. Primary paralysis of the musculospiral nerve indicates a more severe injury to the nerve than does secondary paralysis.

6. The diagnosis of the exact pathological condition of the musculospiral nerve following trauma to it is of the greatest importance and is difficult to determine.

7. Progressive impairment of function or stationary paralysis of the musculospiral nerve complicating fracture of the humerus justifies and may demand operation.

8. Operation means the release of the nerve from compression or tension and often resection and suture, and always guarding against recurrent compression or stretching.

9. A late suture (months after the injury) is attended by

technical operative difficulties not present in an early suture (soon after the injury).

10. Resection of the humerus to allow of approximation of the divided ends of the musculospiral nerve is a good procedure (Allis, Philadelphia) but not until nerve suture *à distance* has first been carefully employed.

11. Electrical reactions cannot determine the pathological condition. They are of value in determining the course of events.

12. The prognosis after operation is good; the earlier a necessary operation is done the speedier the cure.

13. Exercise of paralyzed muscles by electric stimulation (galvanism) is helpful.

14. Sensory symptoms are variable; in general the sensory symptoms have no relation to the degree of motor loss.

BIBLIOGRAPHY.

Berard: Lyon méd., 1904, ciii, 949–956.

Berger, P.: Bull. méd., Paris, 1905, xix, 791–794.

Biso, D.: Tre casi di lesioni traumatiche antiche di nervi periferici. Centralbl. f. Chir., Leipzig, 1901, xxviii, 1072.

Blenke, A.: Ueber Lähmungen des Nervus radialis nach Oberarmfractur und ueber die Behandlung desselben durch Operation. Monatsch. f. Unfallheilk. Leipzig, 1903, x, 1–21.

Boeckel, J.: Bull. Acad. de méd., Paris, 1904, 3, s., li, 365–368.

Bowlby: Lancet, London, July 19, 1902.

Brauninger, H.: Ueber einen seltenen Fall von Radialislahmung, geheilt durch Freilegung und Dehnung des Nerven. Munch. med. Woch., 1900, xlvii, 290, 291.

Bruns, L.: Ueber die Verschiedenheit der Prognose der Plexus- und Nervenstammlahmungen der oberen Extremitat. Neurol. Centralbl., Leipzig, 1902, xxi, 1042–1052.

Bonnet, L.: Bull. et mém. Soc. de chir. de Paris, 1904, xxx, 1096–1100.

Borntraeger: Monatschr. f. Unfallheilk., Leipzig, 1901, viii, 386.

Bournet: Lyon méd., 1905, civ, 340.

Broca: Ann. de chir. et d'orthop., Paris, 1903, xvi, 17–21.

Broca, A. et A. Mouchet: Complications nerveuses des fractures de l'extrémité inférieure de l'humérus. Rev. de chir., Paris, 1899, xix, 701–742.

Coppola, R.: Incurabili, Napoli, 1901, xvi, 321–331.

De Rouville, G.: Bull. et mém. Soc. de chir. de Paris, 1905, xxxi, 1046. 1051.

Dionis du Séjour: Gaz. d. hôp., Paris, lxxvi, 186.

Fairchild, C. S.: Traumatic injury of peripheral nerves. J. Am. M. Assoc. Chicago, 1899, xxxii, 397–401.

Fessler, J.: Die Lagerung des Nervus radialis bei Oberarmbrücken der Diaphyse. Deut. Zeitschr. f. Chir., Leipzig, 1905, lxxviii, 60-120.

Folet: Paralysies traumatiques précoces du nerf radial dans le fracture de l'humérus. Echo méd. du nord, Lille, 1901, v, 444-447.

Geroulanos, G.: Grèce med., Syra, 1903, v. 74.

Gönczy von Biste, B.: Centralbl. f. Chir., Leipzig, 1901, xxviii, 475-477.

Grenet, H.: Gaz. d. hóp., Paris, 1904, xxvii, 1057-1085.

Grisson: Fall von Radialislahmung. Deut. méd. Woch., Leipzig u. Berlin, 1904, xxx, 901.

Hordynski, v.: Militärarzt, Wein, 1901, xxxv, 193.

Jaboulay et Chanoz; Cros et Carayon: Lyon méd., 1901, xcvii, 353-359.

Keen and Spiller: Archives Internat. de Chirurgie, vol. i, fascicule 1, 1903, and Med. Chronicle, August, 1900.

Lannois, P. E., et Lejars, F.: Rev. de chir., Paris, 1903, xxvii, 574-589.

Lehmann, R.: Monatschr. f. Unfallheilk., Leipz., 1897, 269-271.

Leinen: Aerztl. Sachverst. Ztg., Berlin, 1903, ix, 136.

Mally, F.: Rev. de chir., Paris, 1899, xx, 436-450.

Neermann, N.: Om Nervelaesioner ved Frakturer of Extremiteternes Knoglerog deres operative Behandlung. 200 p., Randers, 1904.

Neugebauer, F.: Beitrag. z. klin. Chir., Tübing., 1896, xv, 465-530.

Nogueira Pinto: Las paralysias aposas fracturas de humerus. Rio de Janeiro, 1900.

Paulsen, J.: Ueber Nervenverletzungen bei Frakturen. Kiel, 1899.

Persichetti, C.: Giorn. med. d. R. esercito, Roma, 1897, xlv, 258-262.

Piper: Fractura humeri mit Verletzung des Nervus radialis. Kiel, 1905.

Powers: ANNALS OF SURGERY, 1904, vol. xl, p. 632.

Reboul, J.: Assoc. franc. de chir., Paris, 1898, xii, 422-427.

Reynier, P.: Bull. de l'Acad. de méd., Paris, 1904, 3, s., li, 373.

Reisinger, G.: Kasuistischer Beitrag zur Nervenlösung bei Radialislähmung nach Oberarmfraktur. Beitrag. z. klin. Chir., 1902, xxxvi, 618-629.

Riethus, G.: Ueber Verletzungen des N. radialis bei Humerusfrakturen und ihre operative Behandlung. Beitrag. z. klin. Chir., Tübing., 1899, xxiv, 703-760.

Rixford: Trans. Amer. Surg. Association, 1904.

Ruotte: Arch. prov. de chir., Paris, 1896, v, 350-361.

Savariand: Les complications nerveuses des fractures de l'extrémité inférieure de l'humérus chez les enfants. Abch. gén. de méd. Paris, 1903, 1, 65-129.

Scheffler, E.: Monatschr. f. Unfallheilk., Leipzig, 1903, x, 21-24.

Sherren: Edinburgh Med. Jour., Oct., 1906.

Spieler F.: Jahrb. f. Psychiat., Leipzig und Wien, 1903, xxiii, 415-418.

Strohe: Münch. med. Woch., 1906, liii, 732.

Tixier, L.: Province méd., Lyon, 1896, x, 281-286.

Tonarelli, C.: Morgagni, Milano, 1904, xlvi, 515, 701, 807.

Viannay, C.: Les paralysies des nerfs périphériques et la systématisation des nerfs. i, 59 pp., Paris, 1903.

Vialle: Lyon méd., 1903, c, 663-665.

Vennat, H.: (Monograph) Lyon, 1900.

NOTE ON PARTIAL NEPHRECTOMY.

BY GILBERT BARLING, M.B., F.R.C.S.,

OF BIRMINGHAM, ENGLAND,

Surgeon to the Birmingham General Hospital.

THE operation for partial nephrectomy is so rarely possible that a single instance seems worthy of record.

I published my nephrectomies, numbering 39 in the ten years which terminated March, 1907,[1] and since that time I have probably done some 12 others; but this is my first partial removal of the kidney. Twice I have been inclined to attempt it, but on second thought have resorted to the complete removal of the organ. One of those cases in which partial nephrectomy was tempting, was a hypernephroma of small size limited to the lower end of the kidney. This has already been published with an illustration in the ANNALS OF SURGERY, vol. xliii, 1906. Although the whole kidney was removed, a local recurrence occurred in about a year,—a recurrence which I should undoubtedly have credited to mistake of my own if I had performed a partial removal of the kidney. Another case, one of tuberculosis of the kidney, also offered a pit-fall. There was a perfectly circumscribed cold abscess about the middle of the external border and apparently well shut off from the pelvis. It would have been very easy to take a wedge out of the middle of the kidney, but I have always felt unfavorably inclined to partial operations for tubercular disease in an organ like the kidney, and therefore followed my usual rule of complete nephrectomy, which was shown on the examination of the specimen to be fully justified by the fact that infection of the pelvis and the ureter already existed.

The details of the present case are as follows:

J. M., female, aged 35, was admitted to the General Hospital under my care on January 10, 1909, complaining of pain in the left loin. She had suffered for the last four years from attacks of pain in the same position at intervals of three to four months,

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[1] British Medical Journal, July 13, 1907.

the pain starting about the level of the left iliac crest and shooting upwards as far as the lower ribs. It was of a sharp stabbing nature, generally lasted for some days, and was worse when the patient was up and about than when she was lying in bed. The patient felt sick with the pain, but did not vomit. There was no pain on micturition, or any marked frequency in the day, but she used to get up twice in the night. Examination of the urine showed the presence of pus in considerable and of blood in very slight quantities; the amount of urea was generally about 300 grains or rather less; no tubercle bacilli could be detected.

On palpation the patient was tender over the lower part of the left kidney. Muscular rigidity was marked, so that it was impossible to say with certainty whether the organ could be felt; but it was thought that the lower pole could be palpated and that it was enlarged.

On cystoscopic examination the right ureter was found to be normal. On the left side a normal ureter was found in the normal position, functionating healthily. A second ureteral orifice was then discovered further outwards on the left ureteral bar. This was much larger than the left orifice first mentioned, was very patulous, and no efflux was discovered from it. An attempt to catheterize the ureter unfortunately failed, as the only catheters available were too large to be passed down the particular cystoscope in use.

The patient was now given a general anæsthetic and the left kidney exposed through the loin by the usual oblique incision. Dense matting fixed the lower half of the kidney, and it was with great difficulty that it was brought down into view. It presented the appearance shown in Figure 1. The upper portion of the organ, exactly two-thirds of it, was unusually firm in consistence but otherwise apparently quite healthy; the lower third was in a condition of complete sacculation and presented a yellowish-white color in contrast to the brownish-red of the upper healthy portion. The pelvis of this lower third was much dilated, as was the ureter also (to the size of a No. 14 E catheter). No stone could be detected in the pelvis or ureter. The latter was therefore opened and a bougie passed easily into the bladder, showing the absence of stone or stricture. After considerable search, the second ureter was found clinging closely by dense adhesions to the diseased ureter and dilated pelvis. Much trouble was required to separate the two, and it was feared that the nutrition of the

healthy ureter might have been damaged. The dilated ureter was now clamped and divided. A clamp was next placed on the vessels of the kidney and the lower third of the kidney excised. Lest any renal tissue should be left on the truncated lower end of the upper healthy portion, that end was carefully curetted with a Volkmann spoon, and the end was whipped over with a continuous catgut suture. The clamp was now removed from the vessels; very little bleeding occurred. The remaining portion of kidney was returned into the loin and the wound closed except for a drainage opening.

Shock after the operation was extremely marked, much more so than in an ordinary case of nephrectomy for a pyonephrosis.

FIG. 1.
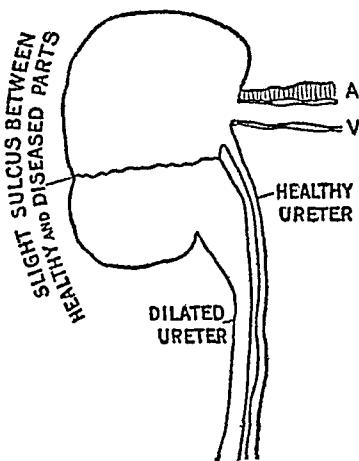
This was due probably in part to the difficulty of stripping out the kidney in the first instance and probably to some extent also to the rather prolonged nature of the operation which occupied much more time than an ordinary nephrectomy.

The patient's recovery was interrupted by a slight febrile disturbance on the ninth day, two days after the drainage tube was taken out, and was probably due to some little leakage from the cutting out of the continuous catgut suture. There was at this time a little hæmaturia. The patient is now quite well in all respects.

The removed portion contained pus and showed a single cavity continuous with the dilated pelvis. Renal tissue was almost completely absent and a section of the walls of the sac failed to find evidence of tubercular infection.

PARTIAL RESECTION OF THE BLADDER FOR MALIGNANT TUMOR BY THE TRANS-PERITONEAL ROUTE.

By ALEXANDER PRIMROSE, M.B., C.M.(Edin.), M.R.C.S.(Eng.),

OF TORONTO, CANADA,

Associate Professor of Clinical Surgery, University of Toronto; Surgeon, Toronto General Hospital.

THE treatment of new growths in the urinary bladder has not been satisfactory. This remark applies not only to malignant growths, but also to the so-called benign ones. Of the latter it is commonly believed that there is a tendency for a simple growth in the bladder to take on malignant characteristics.

The statistics published by Watson [1] indicate with sufficient force the unsatisfactory results of operative treatment. Watson studied 653 cases (243 benign, 410 malignant). These had been under the care of different surgeons. He had found that where a more or less radical operation had been performed for papilloma and myoma, 34 per cent. only were free from recurrence at the end of one year. After similar treatment for carcinoma only 28 per cent. were free from recurrence at the end of a year. He further holds that if operative deaths and rapid recurrences are considered together under the head of "operative failures," such failures have appeared in 28.06 per cent. of benign and 46 per cent. of carcinomatous tumors.

Numerous methods have been adopted for the removal of bladder growths. Operative cystoscopy with the use of the snare or galvanocautery has been employed of recent years. The writer had an opportunity of seeing Casper, of Berlin, during the past summer, operate upon a growth in the bladder by means of the cystoscope. He was removing a tumor from the bladder of a man 72 years of age. This was being accomplished piecemeal, a small portion of the growth being removed every few days by a wire snare. Casper explained that as the

man had patience and sufficient time at his disposal, he approved of this method of operating rather than that of suprapubic cystotomy in a man of his age. Perhaps Casper's attitude towards this patient may be explained by the conclusions to which he has arrived as published in his book on " Genitourinary Diseases," where he states that " patients do better and live longer without than with operation." [2]

From time to time tumors of the bladder have been attacked by suprapubic cystotomy. On exposing the tumor it has been removed by free dissection, the use of the galvanocautery, the employment of a wire snare, or a combination of these methods. In some cases X-ray treatment through the bladder opening has been suggested. In the suprapubic operation, as carried out in the past, two main dangers are emphasized by those who have operated along these lines. The first of these dangers is infection of the prevesical cellular tissue (Retzius's space) ; the second is infection of the peritoneal cavity. Curiously enough, until within the last few years surgeons have dreaded the opening of the peritoneum in operations on the bladder rather than the disturbance of the prevesical space. The writer is firmly convinced that this attitude is entirely erroneous, and from his experience would be inclined to state that the opening up of the prevesical cellular tissue is a very much more frequent cause of serious complications in bladder surgery than is the opening of the peritoneal sac. Infection in the prevesical space is an exceedingly serious complication, particularly in old people with atheromatous vessels. Further, it is much easier to prevent infection of the peritoneum when the bladder is opened by the transperitoneal method than it is to prevent infection of the prevesical space when that is widely exposed during operative procedures upon the bladder.

My paper deals with a case of carcinoma at the base of the bladder. For this condition, in which the treatment hitherto has been so eminently unsatisfactory, total extirpation of the bladder has been advocated of late years. Rovsing of Copenhagen recently reports [3] before the German Association of Surgeons three cases in which he performed this operation.

By this method the bladder is removed through a suprapubic wound and the ureters are carried out into the loin through the space of Petit, where subsequently the urine is discharged. He has succeeded in performing this operation without wounding the peritoneum. The first patient, 34 years of age, was still alive and well when he reported the case eleven months afterwards. The second, a man of 67 years of age, died on the eighth day after the operation; the third, a man aged 57, was alive at the time his case was reported, four weeks after operation. Mayo has advocated the transplanting of the ureters into the rectum in such cases. Paroliks transplants the ureters into the vagina in the female and Sonnenberg carries them into the urethra.

Berg,[4] in the ANNALS OF SURGERY, September, 1904, proposes the removal of the bladder by the transperitoneal method. After opening the abdomen the peritoneum of the pelvic floor is divided straight across. Each ureter is traced down to the bladder and the tumor is removed. The ureters are transplanted into the healthy part of the bladder if they have been involved in the growth. Further, any lymph-glands which may be involved are dissected out from beneath the peritoneum in the pelvis. Drainage is provided through the pelvic floor into the vagina in the female or between the prostate and rectum in the male. The bladder is sutured and the peritoneum is closed over the pelvic floor and the abdomen closed without drainage. Harrington[5] has reported a case of chronic disease of the bladder treated by the transperitoneal incision.

An important contribution to the subject of the removal of tumors of the bladder has been made by Chas. H. Mayo. He has described a simple and efficient means of operating upon these cases by the transperitoneal route. The abdomen is opened above the pubes and the bladder opened by a vertical incision through its peritoneal covering. The tumor is removed and subsequently the wound in the bladder is sutured. Five cases have been operated upon for papillomatous growths without mortality; three of these tumors were carcinomatous, and the others benign.[6]

The following case was operated upon by me on the 17th of January last and the operative procedure as described by Mayo with but slight modification was carried out. The following is a history of the case:

J. W., aged 48 years, was admitted to the Toronto General Hospital under my care on January 15 with a history that three months previously his symptoms of trouble in the bladder began. This consisted in frequency of micturition, pain, and hæmaturia. He went from bad to worse, until finally on admission his condition was almost desperate. The urgency of the case consisted chiefly in the fact that he had not only lost a very large quantity of blood and was profoundly anæmic, but the blood had collected in the bladder and had produced retention, so that he was suffering great pain. On admission the bladder was found distended to the umbilicus. On passing a catheter blood-clots and urine were drawn off with great difficulty, but it was possible to relieve his distress to a considerable extent by this means, and it was hoped that, within the course of a few days, one could improve the local condition before operating. Rectal examination showed a tumor-like mass in the left wall of the bladder, palpation of which caused the patient much pain. No enlargement of the prostate gland could be detected. With a silver catheter in the urethra thickening was very marked on the left side of the bladder in the region of the seminal vesicle. When seen on Sunday afternoon, two days after admission, the bladder was again greatly distended and the patient was suffering intensely. He had broken out in a cold perspiration and he was loud in his expression of the wish that death would relieve his sufferings. Operation was immediately undertaken for his relief and the following procedure was carried out.

The patient was anæsthetized and placed in the high Trendelenberg position. An incision was made in the middle line from the pubis to an inch and a half above the umbilicus. On opening the peritoneum it was found that the bladder was distended very markedly, so that the prevesical fold of peritoneum was fully two inches above the pubic bone. Several long strips of gauze were placed in position in such fashion that the abdominal viscera were excluded from the pelvis and thoroughly protected. The bladder was then incised through the peritoneum by a vertical

incision on its posterior surface three inches long. It contained blood-clot of the color and consistence of red currant jelly. There was no urine distinguishable from this mass, save a small amount of port-wine-colored fluid (perhaps two ounces) which lay in the bottom of the bladder. A portion of the blood-clot was lifted out by the hand and the remainder by a sterile tablespoon, and thus the bladder was emptied. The inner wall was now inspected and a tumor was observed on the floor of the bladder, situated on the left-hand side, forming a patch about 7 cm. in diameter. On close inspection it was found that the ureter entered the lower portion of this mass, the margin of the tumor extending 1 cm. beyond the mouth of the ureter towards the prostate. The right margin of the tumor was about 1 cm. from the middle line. The incision in the posterior wall of the bladder was extended down to within a centimetre of the tumor, and then the whole thickness of the bladder wall, including the peritoneal coat, was cut through to the left and right of the tumor at a distance of 1 cm. from its margin. It was now found that the lowest portion of the tumor lay below and anterior to the line of reflection of the peritoneum on the posterior wall of the bladder; consequently, in order to reach that portion, the peritoneum was divided transversely about 2 cm. above the lowest point of Douglas's pouch. The left ureter was recognized through the peritoneum, and was subsequently found as it passed into the tumor mass anterior to the peritoneum. It was found to be dilated sufficiently to admit a structure the size of an ordinary lead pencil.

The vas deferens was observed passing over the ureter towards the middle line. The mucous membrane was now divided by means of the scalpel 1 cm. below and anterior to the tumor, this incision being carried in a curved direction so as to divide the mucosa 1 cm. from the lower margin of the tumor mass. The tumor was thus completely separated from its connections and was pulled up out of its bed with the ureter still attached to it. The ureter was now divided transversely 1 cm. from the point of its entrance into the tumor mass. On inspection, the bed from which the tumor had been enucleated was found to consist of the floor of the pelvis, in which the fibres of the levator ani were exposed.

The ureter was first of all secured by stitching it to the wall of the bladder as it passed through beneath the peritoneum. The

extremity of the ureter was carefully stitched to the mucous lining of the bladder at a point where the cut in the mucosa had been brought together by three or four interrupted catgut stitches. It was thought wise not to attempt complete closure of the mucosa where the enucleation of the tumor had left a bare area in the floor of the pelvis. A raw surface in this locality was consequently left which measured perhaps 4 cm. in diameter. The bladder was now closed towards the peritoneum by a series of No. 2 sterile catgut stitches, the Connell stitch being used, beginning at the bottom of Douglas's pouch and extending all the way on the posterior surface of the bladder to the prevesical fold above. A very successful turning in of the edges was thus accomplished. This closure was supplemented by sterile linen thread, No. 1, from the bottom of Douglas's pouch to the prevesical fold carried as a continuous Lembert suture.

Douglas's pouch was now swabbed out with some warm normal saline solution. The strips of gauze were removed and the abdominal wound closed. A large-sized rubber catheter was left in the urethra for the purpose of draining the bladder. The laparotomy wound was closed by No. 1 catgut in the peritoneum, and then by a series of interrupted silkworm gut sutures, the skin edges being approximated by horse-hair.

The patient made an excellent recovery from the operation. He lost all his pain and distress and passed water freely by the urethra. There was very little hæmaturia and he was soon able to leave the hospital completely relieved.

The case which I have reported illustrates well the possibilities of relief in this serious class of bladder affections. It is somewhat remarkable that the definite procedure which was adopted in this case has not long ago been suggested when so much advance has been made in recent years in the treatment of surgical conditions within the peritoneal cavity. I close this paper with the suggestion that in all probability the future will show that it is much less dangerous to approach the bladder in such cases through the peritoneum than by opening up the prevesical space of cellular tissue. It is possible that ere long the prostate gland may be attacked by the transperitoneal method. The question may well be asked: Why not

remove growths from the bladder and subsequently close the opening by bringing the serous surfaces in contact after the manner adopted in connection with tumors of the intestinal tract, or for surgical conditions in other viscera ? With proper precautions one may readily believe that the opening of the bladder through the peritoneum is not nearly as likely to result in peritonitis as is the opening of the bowel through its serous coat.

References.

1 The operative treatment of tumors of the bladder, F.S.Watson. Annals of Surgery, 1905, vol.xlii, p.806.

2. Text-book of genito-urinary diseases, including functional sexual disorders in man, Leopold Casper, translated by C.W. Bonney, 1906, p.263.

3. Total extirpation der Harnblase mit doppelseitiger Lumbaler Ureterostomie, T. Rovsing. Zeit. für Chir. (Deut.Gesell.für Chir.), xxxi, 1907, p.94.

4. A radical operation for malignant neoplasm of the urinary bladder, A.A.Berg, Annals of Surgery, 1904, vol.xl, p.392.

5. On the feasibility of intraperitoneal cystotomy, with report of a case, F.B. Harrington, Annals of Surgery, 1893, vol. xviii, p.408.

6. Transperitoneal removal of tumors of the bladder, C.H.Mayo, Annals of Surgery, 1906, vol.xliii, p.105.

Acute Haemorrhagic Pancreatitis

Report of a case subjected to operation terminating in recovery.

By James R.Judd,M.D.
of Honolulu,Hawaii.

Mrs.M.,28 years of age,German,was seen at the Queen's Hospital,August 26,1908.in consultation with Dr.W.L.Moore. The following history was obtained: Four years ago she suffered from a severe attack of "indigestion" lasting for four days. The attack was characterized by vomiting,constipation and severe pain in the upper abdomen. Six months ago while in New York City,she had an attack of renal colic followed by the passage of several small stones. She had been troubled with constipation for years and was in the habit of taking pills.

Present history: The day previous to her admission to the hospital she had eaten a hearty supper,consisting of fried pork chops,and in the morning had taken some aperient pills and had followed with some fruit salts. Shortly afterwards severe, knife-like pain commenced in the epigastrium,and the patient was so prostrated that she could hardly get to bed. Vomiting then began and persisted. The pain tended towards paroxysmal,was increased on movement and was only partly relieved by anodynes and heat to the abdomen. There was considerable prostration,which was combated by hypodermic stimulation and heat. The bowels had not moved,although several enemata containing ox-gall and turpentine had been given. The patient was then moved to

the hospital and was seen by me about thirty hours after the onset of the attack.

Physical Examination: This showed a small woman of 106 pounds, with facial expression of prostation and suffering. The patient laid with her knees drawn up and complained bitterly of the pain in the epigastrium. Temperature 99.4; pulse 90, small and feeble; respiration 26. There was no jaundice. Heart and lungs negative. The abdomen was somewhat distended. There was considerable muscular rigidity and tenderness on palpation, most marked to the right of the umbilicus. The percussion note

was tympanitic with slight dulness in the flank and liver dulness not obliterated. Pelvic examination was negative. Vomitus consisted of dark bilious fluid mixed with mucus.

Urinalysis: Yellow, acid, 1.024, no albumin or sugar. Microscopical examination negative. Cammidge test was not attempted. Leucocyte count showed 25,000 white cells. No differential count was made.

Immediate laparotomy was advised and undertaken.

Operation: Anæsthetic, chloroform. In order to insure that the appendix was not at fault, incision was made over that organ. On incising the peritoneum considerable blood-stained fluid was met with and the peritoneum, both parietal and visceral, was acutely inflamed. The appendix showed the gross evidences of a chronic inflammatory process plus the general congestion, and was removed. This incision was then closed and an epigastric incision in the middle line was made. Blood-stained fluid and inflamed peritoneum were encountered. The gastrohepatic omentum showed the characteristic areas of fat necrosis resembling spots of candle grease. The lesser omentum was very friable and was easily torn through. This disclosed the lesser sac partially filled with bloody serum, and the pancreas enlarged, swollen, soft and purplish in color. An opening was made into the head of the pancreas with a blunt instrument and a cigarette drain inserted leading out above the stomach through the gastrohepatic omentum. The gall-bladder and ducts showed no stones and were apparently in normal condition. The wound was then closed, except for the space occupied by the drain, and another drain inserted through a suprapubic stab wound. The patient was put to bed with the head of the bed raised and was given normal saline solution per rectum. Steady improvement followed the operation. There was considerable drainage of a thin, bloody fluid for the first twenty-four hours, which rapidly diminished and by the third day drainage had practically ceased. The temperature reached 101.4 on the second day, and was elevated one to two degrees for twelve days, after which time it remained normal. The pain continued, although of less intensity, for three days and required several hypodermics of morphine. The bowels moved voluntarily on the fourth day, followed by a profuse diarrhœa for several days. Convalescence was then uneventful and the patient returned home during the fourth week. Since

the operation, nine months ago, she has enjoyed good health and at the present time is in splendid condition.

Considering briefly the etiology, gall-stones and septicæmic infections being excluded, infection from the duodenum would seem to be the most likely etiological factor. Whether any credit may be given to a poorly digested quantity of pork chops, followed by a number of cathartic pills, is open to doubt.

According to the patient, the previous attack four years ago was similar in its symptoms, except in their severity. This brings up the question of the responsibility of small hemorrhages occurring in the gland, with spontaneous recovery and not recognized as such.

The characteristic description as given by Fitz in 1889, and not improved upon since, is a valuable one to have in mind. " Sudden, severe, often intense epigastric pain without obvious cause, in most cases followed by nausea, vomiting, sensitiveness and tympanitic swelling of the epigastrium. There is prostration, often extreme, frequent collapse, low fever and a feeble pulse."

The question as to whether the hemorrhage precedes the inflammation, or whether the inflammation precedes the hemorrhage, could not be settled in this case. According to the descriptions as set forth in Mayo Robson's admirable work, entitled " The Pancreas: Its Surgery and Pathology," the case may be regarded as of the ultra-acute variety, in which the hemorrhage precedes the inflammation.

Cyanosis of the face and a general lividity of the skin noted by Halsted, Jacobson, Moynihan and others was not present in this case.

The condition being such a rare one, the diagnosis will seldom be made on the surgeon's first case. The persistent vomiting and constipation suggested intestinal obstruction, but the severity of the pain and the lack of any fecal odor were against it. Perforation of a gastric or duodenal ulcer was discredited by the lack of any preliminary history indicating such a condition. The presence of liver dulness was also against it. Perforative appendicitis was suspected, as the

point of greatest tenderness was to the right of the umbilicus, but the excruciating pain and absolute constipation were arguments against it.

The important point in treatment is, as Moynihan succintly says, "the surgeon will feel that some acute catastrophe has occurred in the abdomen and that in operation alone lies the hope of relief."

The mortality is high. According to Mikulicz's much quoted statistics (ANNALS OF SURGERY, May, 1903), there were on record 75 operations for acute pancreatitis, with 29 deaths. Later compiled statistics will probably show a larger percentage of recoveries.

PANCREATO-ENTEROSTOMY AND PANCREATECTOMY.

A PRELIMINARY REPORT.

BY ROBERT C. COFFEY, M.D.,

OF PORTLAND, OREGON.

Food is prepared for appropriation almost exclusively by derivatives of the primitive foregut (the stomach, liver and pancreas). The upper portion of the primitive foregut lies between the layers of the partition of the primitive body cavity which extends anteroposteriorly. That portion of the partition in front of the foregut is called anterior mesogastrium, while that lying behind the primitive foregut is called posterior mesogastrium. Early in fetal life a bud projects off from the primitive tract between the layers of the anterior mesogastrium and forms the liver and bile tracts. Another bud which is supplemented by a secondary one, projects from the primitive alimentary tract backwards between the layers of the posterior mesogastrium, and after blending form the pancreas and pancreatic ducts, the chief of which empties into the alimentary canal through a common opening with the liver duct. The stomach, representing the upper expanded portion of the primitive foregut, always remains between these two layers of membrane which becomes peritoneum, therefore is surrounded on all sides by a peritoneal coat. The liver with gall-bladder develops between the layers of the anterior mesogastrium and therefore is always covered with peritoneum. During the process of intestinal rotation which occurs in fetal development, the pancreas and second and third portions of the duodenum are thrown out of the peritoneal cavity.

As surgery becomes a more definite science we are learning that the peritoneum is an essential in almost all abdominal surgery, and in addition to forming a smooth covering and

strong support it has another function equally important: namely, that it throws out exudate when injured, which serves a purpose similar to the callus thrown out in the repair of broken bone. This exudate penetrates the adjacent tissues for some distance around. In the course of a few days the exudate or "callus" becomes organized. The bulk of the exudate is soon absorbed, leaving the firmer elements, so that the repair is soon complete and the broken surface covered by a new and smooth peritoneum.

The gall-bladder, which is a part of the hepatic structure ordinarily used for surgical purposes because of its convenience and peritoneal covering, and the stomach, have been conquered by the surgeon and brought into the actual and legitimate domain of surgery, while the pancreas remains technically almost a stranger to the surgeon. Many reasons have been given for this, but to the mind of the writer the one most plausible is based on the premise that the fundamental defect in the pancreas, as far as surgical work is concerned, is that it is devoid of peritoneum, and it was with this principle in view that experiments were begun some months ago.

The fat-splitting ferment of the pancreatic juice has been the terror of surgeons up to date, but in a close study of results which have been obtained by experimenters, we fail to find any positive evidence that even pancreatic juice will penetrate peritoneum to a serious extent. The fat-splitting ferment seems to travel in the planes of the areolar connective tissues, outside the peritoneum; therefore it proves serious because of the anatomical position of the pancreas, but not so serious as the contents of the intestinal canal would be by escaping in the same neighborhood. So it seems that the principal danger of pancreatic juice in surgery is not that it is so virulent itself, but because it escapes into the retroperitoneal fat. Consequently, the principal problem was to provide unbroken peritoneum with which to surround the part of the pancreas participating in the formation of the operative field. Two methods were considered as being applicable to the situation. First, implantation of the cut end of the remaining pancreas

into the intestine, using the peritoneum of the intestinal wall to make the union. Second, a direct implantation of the duct into the intestinal wall and fastening a collar of omentum around the duct and pancreas at the point of intended union. The first method seemed much the better and was used exclusively in the first series of operations reported below. The first attempt was to implant the cut end of the pancreas into the side of the intestine, which proved to be impractical. The next thought was to invert a cut end of the intestine and implant it there. This was done in two instances, but the post-mortem showed that the end was too small, as it constricted the end of the pancreas, causing its death. (There might, how-ever, be conditions in which this would be a suitable method, in which cases it would be ideal.) After considering the anatomy of the intestine it was thought feasible to throw the lumen of two intestines into one by using a loop and thus give ample room for implanting the pancreas. The perfected technic resulting from the experiences of the two series of operations reported below, and which is recommended for use, is illustrated by Figs. 1 to 12 and may be described as follows:

First, pick up a loop of intestine, preferably jejunum, using care that mesentery at the point is long enough to reach the pancreas with ease. Clamp both arms of the loop with a rubber-covered stomach clamp, leaving the loop three or four inches long. Suture the intestines together with con-tinuous Lembert suture near the mesenteric edge to a point near the clamp. Grasp the thread with a forceps at this point and hold till all other steps of the operation are com-plete (Fig. 1, *C. 1*).

Second, with knife or scissors open the intestine around the loop (Fig. 2), (indicated by dotted line in Fig. 1) one-fourth inch from line of suture, thus cutting the two intestines into one.

Third, with through-and-through continuous suture begin-ning inside (Fig. 2, *C. 2*) and continuing around (Fig. 3, *C. 2*) close the loop, leaving but a single lumen. Stop when the end resembles the cut end of a single intestine, and tie knot,

Suturing arms of intestinal loop together with primary continuous Lembert suture, C 1. (dotted line indicates where incision is to be made).

C. 1

C. 2

F. C. INHHAR, Jr.

R. C. COFFEY

Opening intestinal loop and beginning the through-and-through suture, C_2. C_1, primary continuous Lembert suture.

Fig. 5.

C 2.

C 2.

C 1.
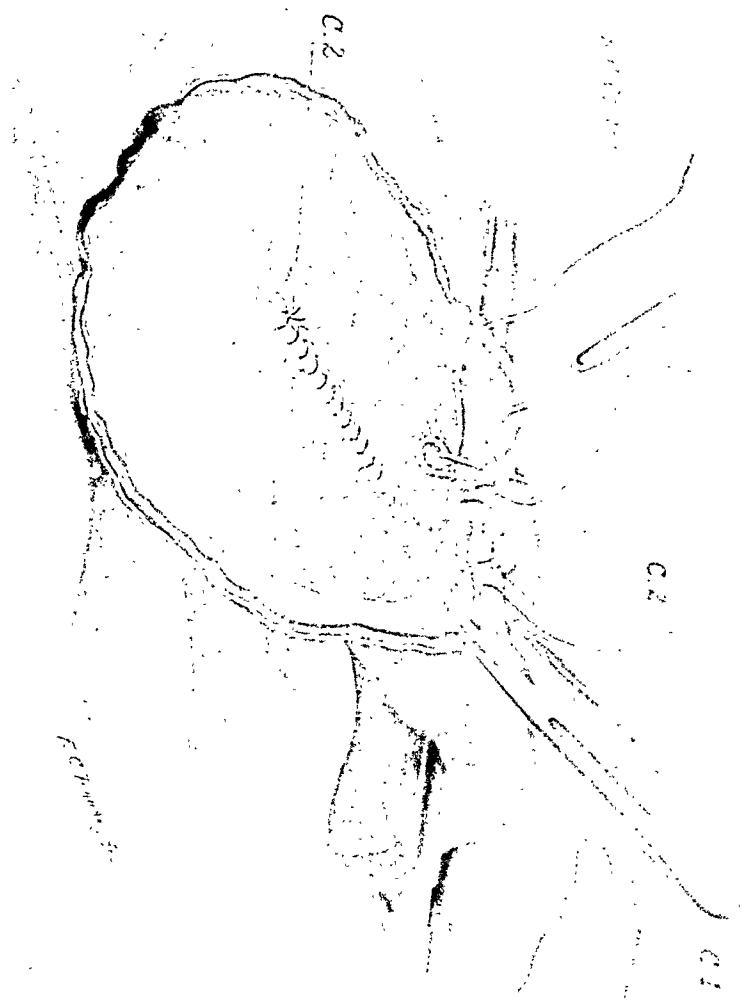
Converting two arms of intestinal loop into a single lumen by continuation of through-and-through suture, *C* 2. *C* 1, primary continuous Lembert suture.

Fig. 4.

Placing intestinal traction sutures, *I.T.S.* *C* 1, primary continuous Lembert suture. *C* 2, beginning and end of through-and-through suture.

Passing intestinal traction sutures (*I.T.S.*) into the lumen and out through the wall of the intestine. *C₁*, primary continuous Lembert suture. *C₂*, through-and-through suture used for traction.

R.C.COFFEY

BLOOD VESSELS LIGATED ----

F.C TRAHAR. fec
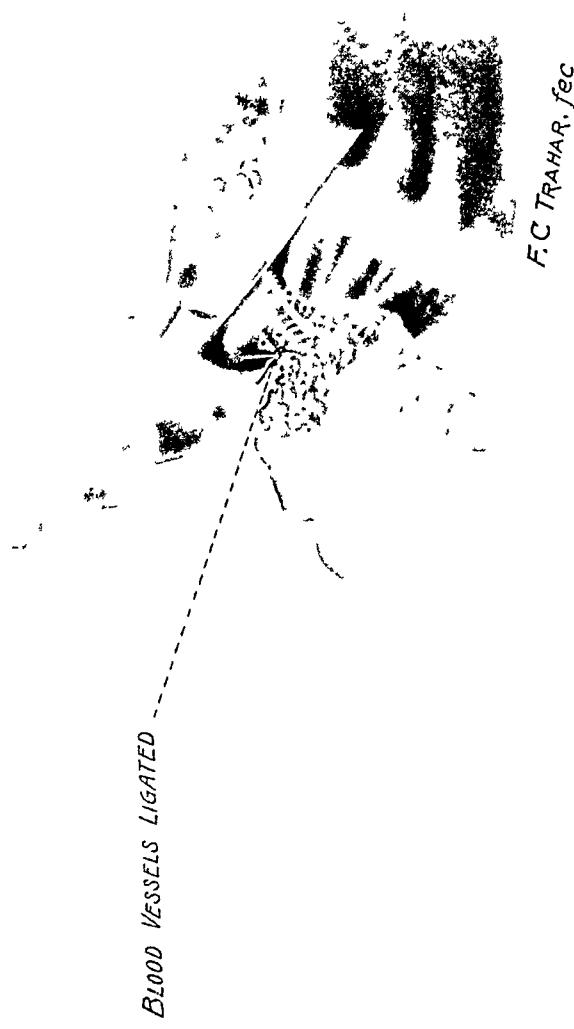
Stripping pancreatic substance from the duct
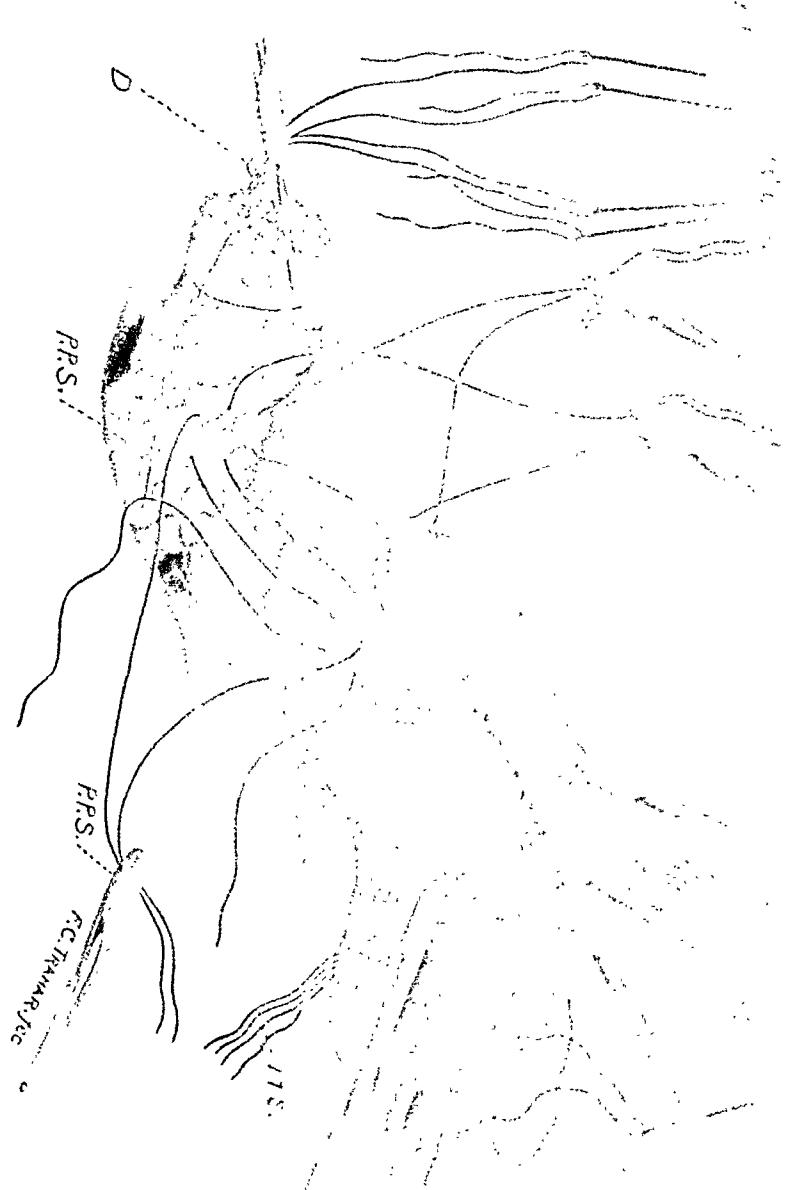
Preparing to introduce cut end of pancreas into lumen of inverted gut. *P.T.S.*, Pancreatic traction sutures which are to be threaded into a single needle and passed into the lumen and out through the wall of the intestine. *P.P.S.*, Posterior pancreatic sutures passed through the intestine and pancreas and left loose until cut end of pancreas is drawn into place. *I.T.S.*, Intestinal traction sutures maintaining inversion. *C.1.*, Primary continuous Lembert suture. *D.*, Duct.

Placing anterior pancreatic sutures which are to be covered by tying the collar suture. A.P.S., anterior pancreatic sutures. C.S., collar suture. I.T.S., intestinal traction suture maintaining inversion. P.T.S., pancreatic traction sutures maintaining the position of the pancreas. C.1. continuous primary Lembert suture.

A.P.S.

I.T.S.

P.T.S.

C.S.1

C.S.2

I.T.S.

F.C.Ihanaki-fec
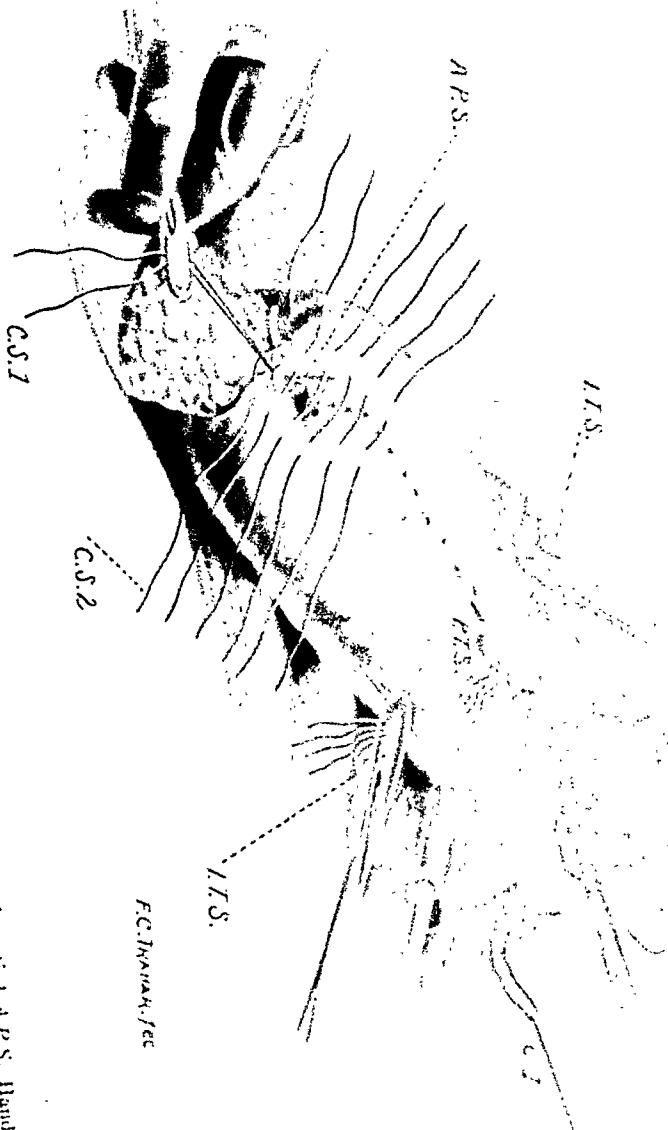
Completing the collar of intestine around the pancreas, the anterior pancreatic sutures having been tied. A.P.S. Hands indicate traction and counter traction on the collar suture 1, and pancreatic traction sutures while other sutures are being placed. I.T.S., Intestinal traction sutures. P.T.S., Pancreatic traction sutures. C.S. 1, Collar suture one. C.S. 2, Collar suture 2. C. 1, Continuous primary Lembert suture.

FIG. 10.

C. 1

R C COFFEY

C S 1

C S. 2

F. TRAHAR
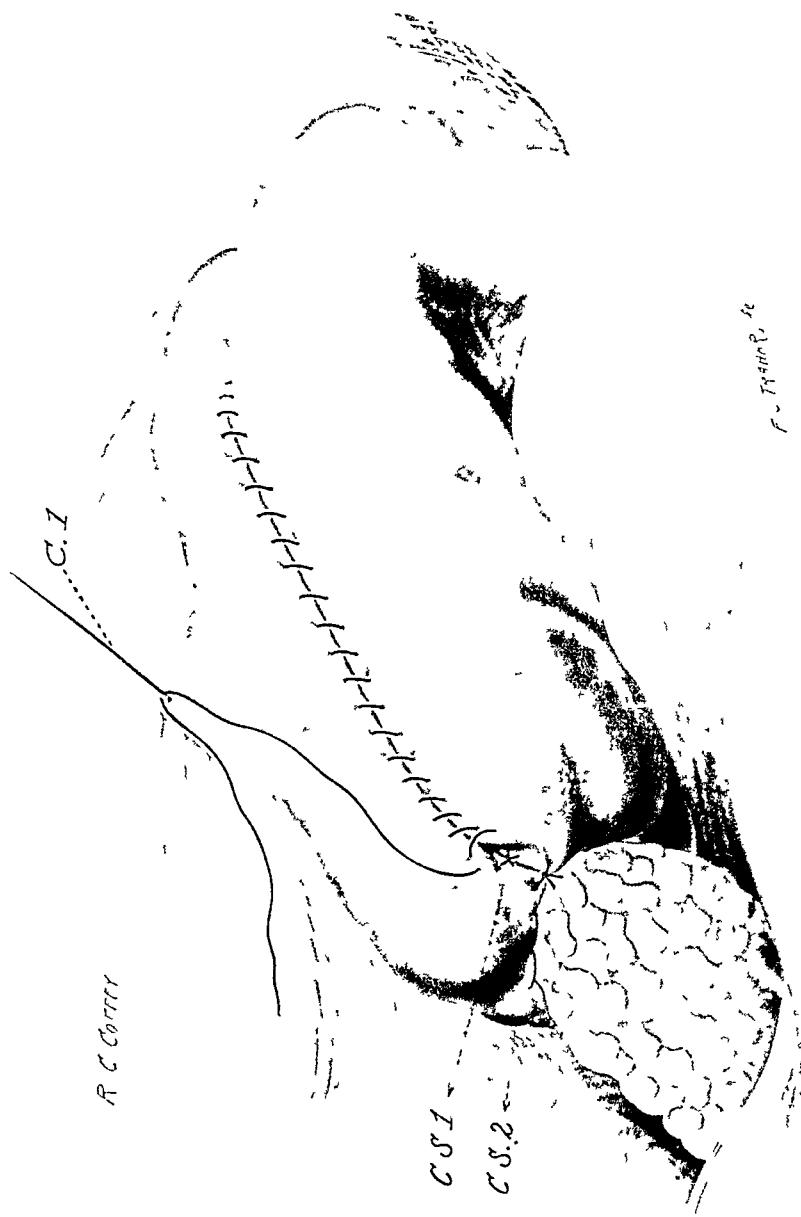
Completing operation with the primary continuous Lembert suture.

leaving the suture long (Fig. 4) to be used later as a traction or inversion suture (Fig. 5).

Fourth, pass four or more traction or inversion loops through the edge of the intestine (Fig. 4).

Fifth thread the two ends of each traction suture, also the single end of C. 2, through large eyed needles, and pass them into the lumen and out through the wall of the intestine one and one-half to two inches back of the cut edge (Fig. 5). By pulling on these sutures the intestine is perfectly inverted when the traction sutures are caught by forceps to maintain inversion, and thus keep a clean field (Fig. 7), while the operation progresses.

Sixth, with the back of a scalpel, strip the pancreatic tissue from the duct and vessels, ligate the vessels, split the duct and cut it so as to leave one quarter to one half an inch protruding beyond the pancreatic tissue (Figs. 6 and 7).

Seventh, complete the required operation on the pancreas and pass a quilt suture (using a needle on each end of the thread preferably) from each side of the pancreas at a point near the end to be implanted. These sutures are to be used as traction sutures in pulling the pancreas into the lumen of the inverted gut (Fig. 7). Owing to the friability and the seriousness of tearing it during the operation it is necessary to avoid traction on the sutures which are to fasten the pancreas to the peritoneum of the intestine. Therefore it is well to pass four or more sutures, which include a bite of the pancreas and a corresponding bite of the intestine, grasping both ends of each suture with forceps as it is placed, to avoid entanglement (Fig. 7). These sutures are designated posterior pancreatic sutures (P. P. S.). Now thread all the pancreatic traction sutures into a large-eyed needle and pass the needle into the lumen well above the inverted edge and out through the intestinal wall near the line of sutures so the final continuous Lembert suture (C. 1) will cover the hole. By traction on these sutures draw the end of the pancreas into the lumen until the corresponding points of the pancreas and intestine which are caught by the posterior pancreatic suture

Fig. 11.
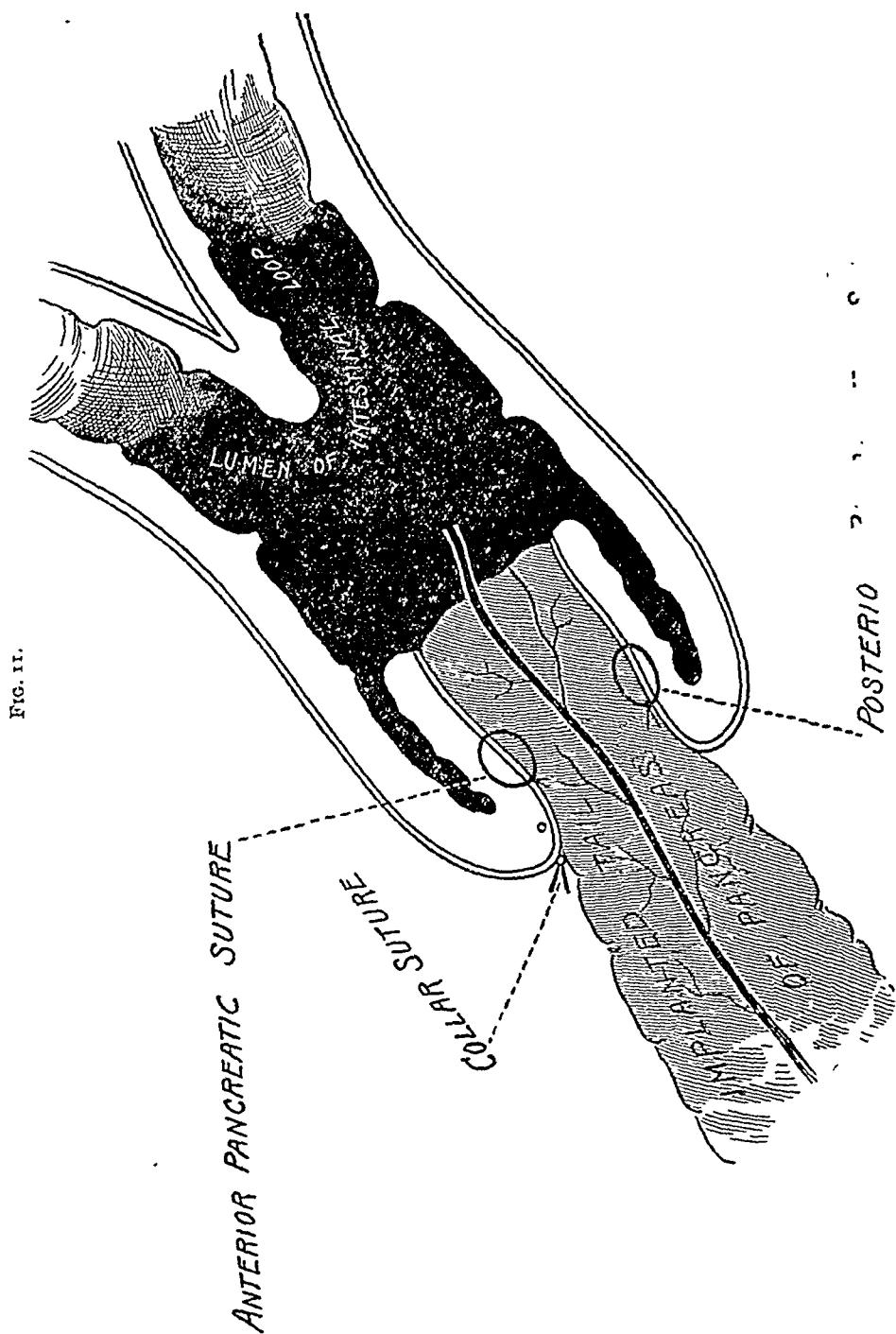
are in contact, when the sutures are gently, but firmly tied and cut.

Eighth, pass four or more anterior pancreatic sutures

FIG. 12.

A. C. COLLEY

F. C. TRABABR, del.
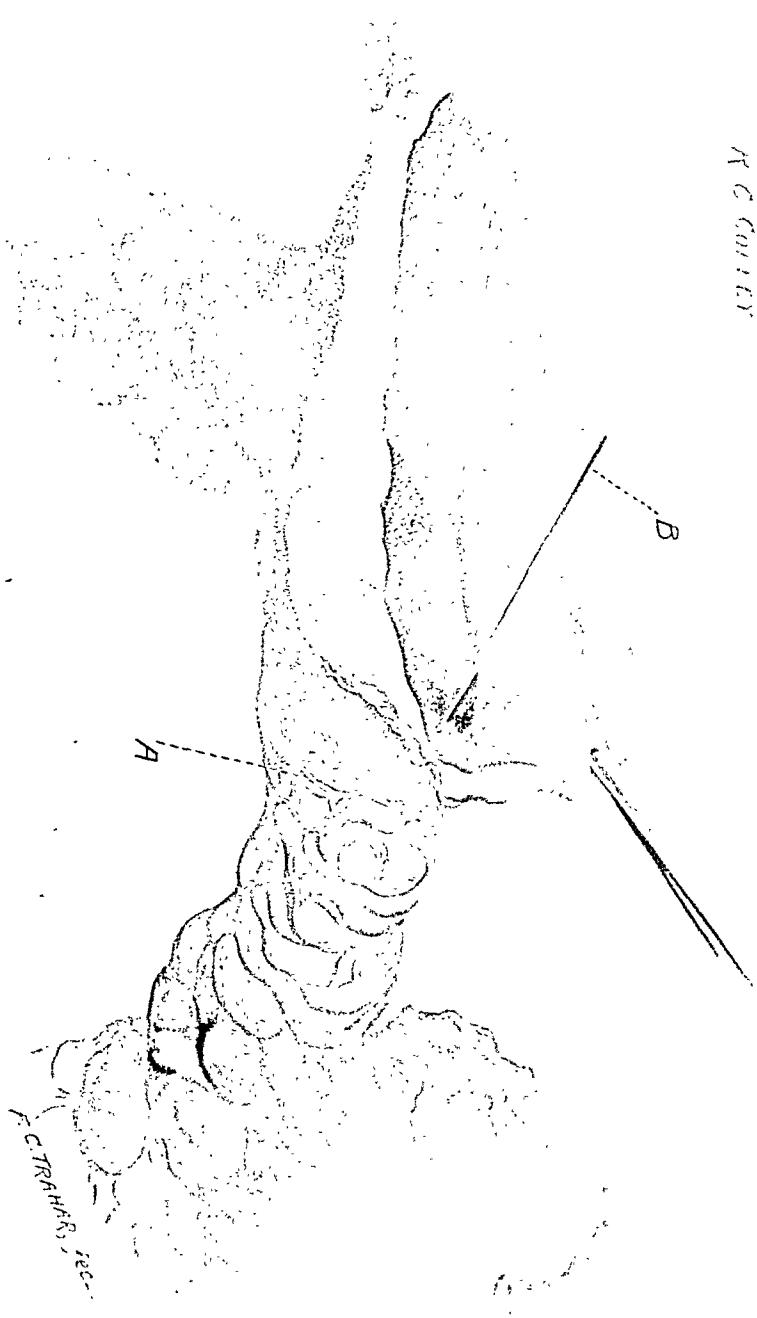
Drawing from fresh specimen removed from dog five weeks after operation, showing result of pancreato-enterostomy. A, line of union between pancreas and intestine. B, probe in open end of pancreatic duct. C, intestinal lumen through the loop.

Fig. 13.
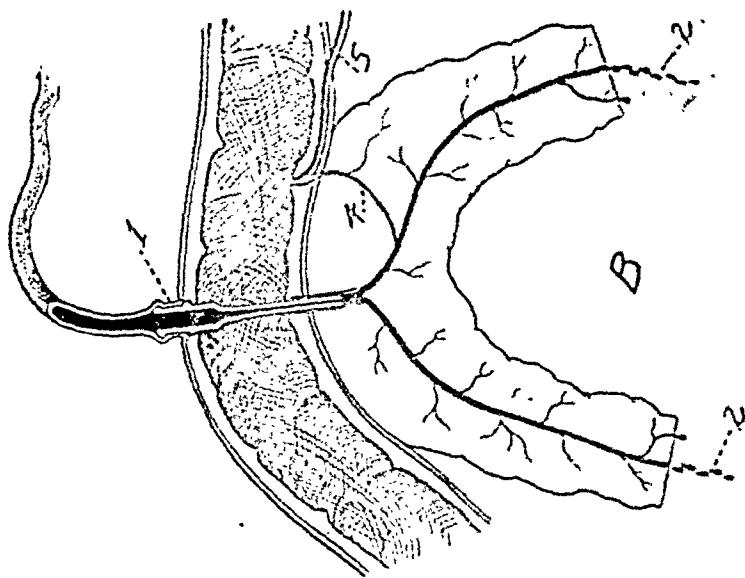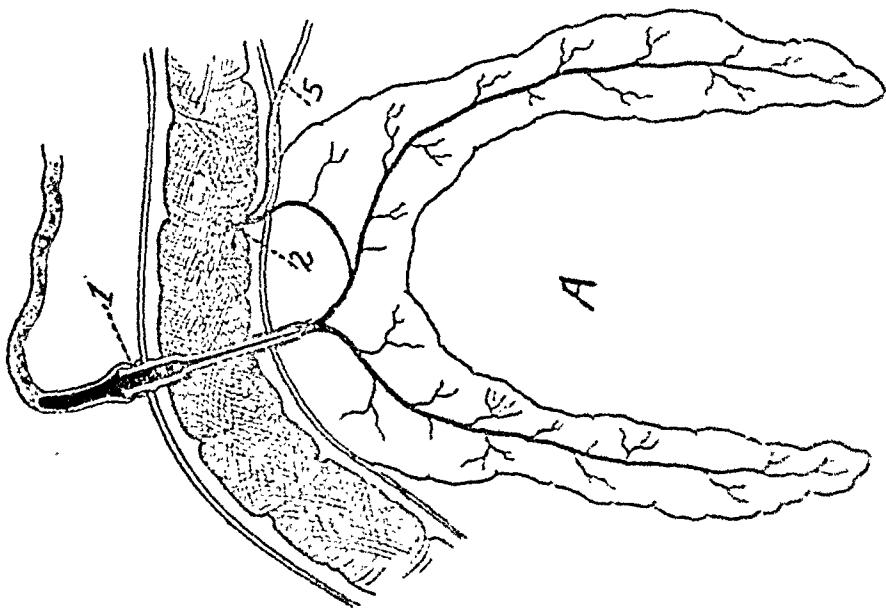
including a bite of pancreas and intestine (Fig. 8, *A. P. S.*) in such a manner that the sutures will form a circular row continuing the posterior pancreatic sutures. Grasp the two ends of each suture with a forceps as soon as it is passed

Ninth, pick up the intestine on each side of the pancreas with a suture at such a distance as will permit it to be drawn loosely around the pancreas in the form of a collar. Make counter traction on the pancreatic traction sutures (*P. T. S.*) while the collar suture (Fig. 8, *C. S.* 1) is being drawn below the pancreatic sutures. The anterior pancreatic sutures (*A. P. S.*) should now be tied within the collar suture before the collar suture *C. S.* 1, Fig. 8 is completely tied. A second collar suture (Fig. 8, *C. S.* 2) is placed below this one at points which will draw the intestine snugly enough to prevent leakage, but not tight enough to constrict the circulation or duct. This point, of course must be left to the personal equation of the operator. After these sutures are tied, two or three more sutures are used to close this space. While these remaining sutures are being placed, an assistant makes traction on the collar suture with one hand, and on the pancreatic sutures with the other, to avoid tension on the pancreatic sutures till the operation is completed (Fig. 9). Thus both the anterior and posterior pancreatic sutures are included within the peritoneal collar which has been placed around the pancreas. All traction sutures are now cut short and allowed to drop back into the intestine.

Tenth, continue the primary Lembert suture (*C.* 1), which has been held in the forceps during the operation, around to the pancreas, covering all previous sutures (Fig. 10).

Eleventh, as an additional safeguard (which is possibly an unnecessary refinement), we have wrapped omentum around the point of union and stitched it there.

FIRST SERIES OF EXPERIMENTS.

Our work has all been done on dogs—the dog's bile tracts are practically the same as in man. The pancreas, instead of being a long straight organ, is arranged in the shape of a horseshoe, from which a tail extends back of the stomach to the hilus of the spleen, thus corresponding to the human pancreas. For want of a better name, we have designated this the retrogastric tail. The other tail follows the concavity

of the duodenum, lying loosely between the peritoneal folds of the mesentery. In operating on this tail it is necessary to strip off these layers of peritoneum from the pancreas in order to make it conform to the human pancreas, which is largely extraperitoneal. The ducts of the two tails meet at the toe of the horseshoe to form the duct of Wirsung, which is from one-fourth to three-fourths inch in length and empties into the duodenum one to two inches below the opening of the bile duct. The duct of Santorini usually has a common opening with the bile duct. This duct has been present in all of our dogs and seems to drain an area of the pancreas more or less independent of the greater pancreatic duct, but one or more of its branches connect it directly with the greater duct. The connection seems to be much the same as a canal used to connect the branches of two rivers which flow in opposite directions from the top of a watershed. If a nozzle attached to a fountain syringe filled with methylene blue solution is tied in the duct of Wirsung and the fluid allowed to run, the pancreas rapidly becomes stained throughout, but is a more faint blue toward the surface. If the pressure is considerable, the fluid after a time finds its way through the duct of Santorini (Fig. 13, A). If the ends of the tail are cut off the fluid flows out without apparent resistance and does not pass through the duct of Santorini (Fig. 13, B). If the duct of Wirsung is ligated, and if the pancreatic tissue is scraped off from the duct of one tail, and if the tip of the other tail is cut off, fluid introduced into the bared duct of the one tail easily (Fig. 13, B) passes around and out at the end of the other tail, and sometimes, in this experiment, the fluid flows through the duct of Santorini simultaneously with the flow through the cut tail, while at other times it does not, but in all cases will begin to flow through the duct of Santorini if the open end of the cut duct is held with forceps. These experiments hold good in both living and dead animals.

If the tail is implanted into a loop of intestine by the method we have just described, and if both arms of the loop are clamped below, so as to shut the loop off from the inter-

tinal canal, fluid introduced into the duct of Wirsung flows through the duct of the implanted end and distends the loop, without leaking at the point of anastomosis (Fig. 14, *B*).

FIG. 14.
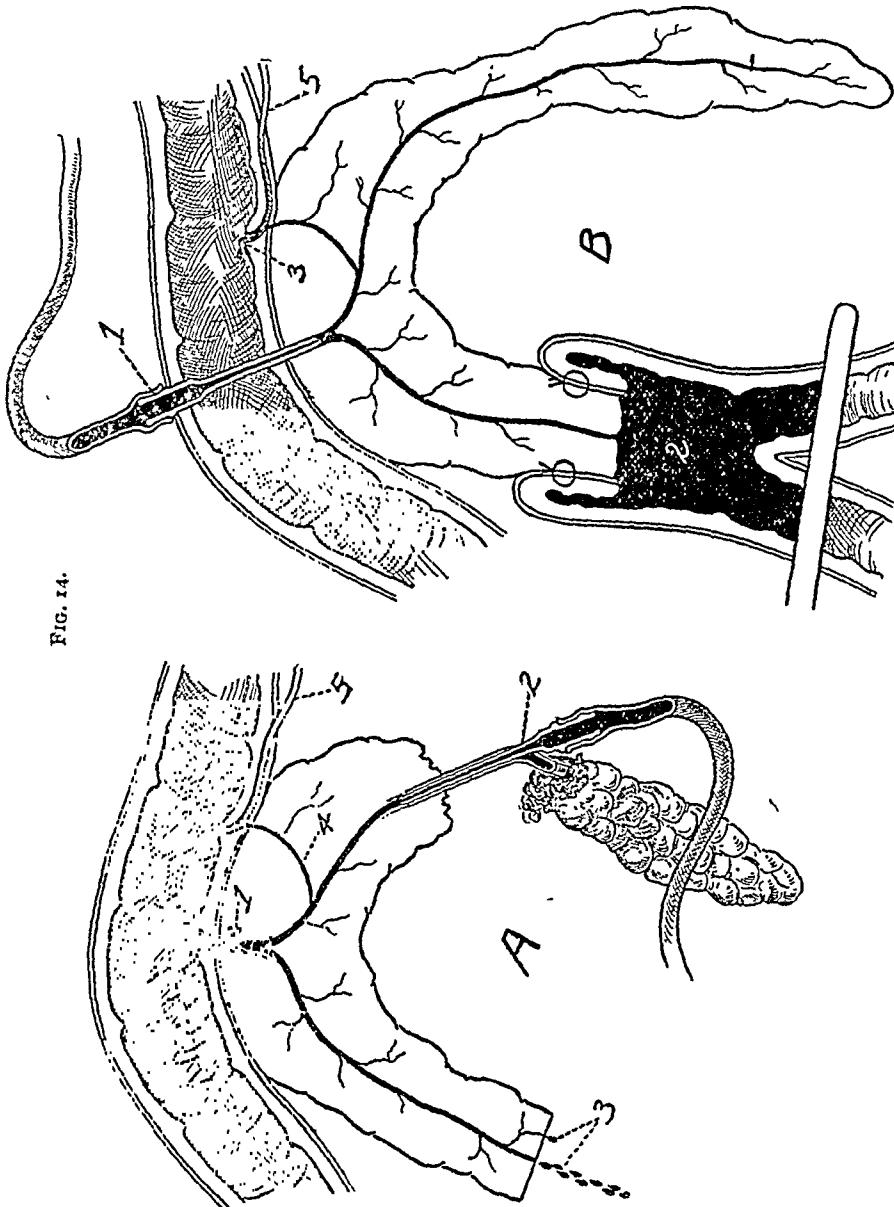
Diagram illustrating the surgical anatomy of a dog's pancreatic ducts. *A* 1, Duct of Wirsung, ligated. *A* 2, Nozzle carrying methylene blue solution inserted into duct of retrogastric tail of pancreas. *A* 3, Fluid dropping out of ducts of cut end of duodenal tail. *A* 4, Fluid in duct of Santorini not delivered into intestine until duct of duodenal tail is clamped. *B* 1, Nozzle carrying methylene blue solution into the duct of Wirsung. *B* 2, Intestinal loop distended with methylene blue solution after pancreatio-enterostomy. *B* 3, Drops of fluid forced out through the duct of Santorini under pressure fr··· distended intestinal loop. *A* 5 and *B* 5, Bile duct.

Thus, by the foregoing study, we demonstrate the anatomical possibility of the following procedures: First, the surgeon can in cases of either malignant or non-malignant obstruction at the outlet of the pancreatic duct or in the duo-

colic artery, which is followed by gangrene of a part of the colon.

Remove the head of the duodenum and pancreas as follows: A median incision from the ensiform to below the

FIG. 25.
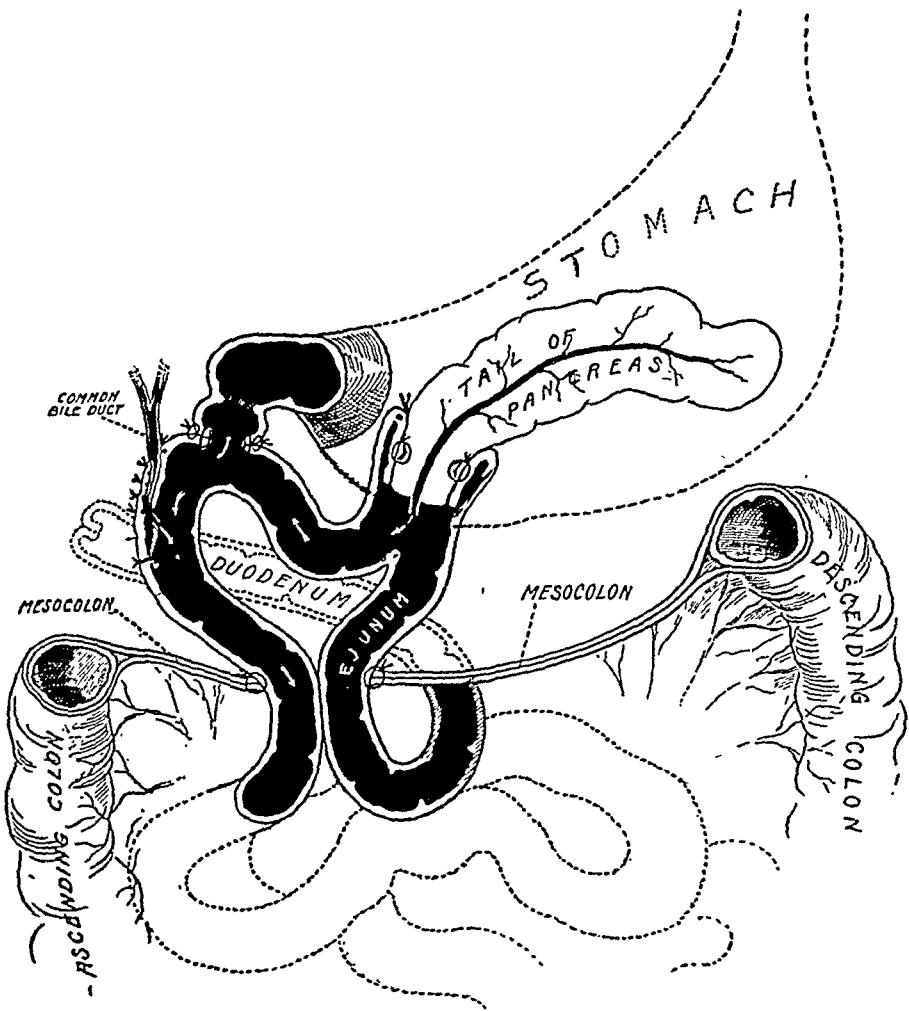
SCHEME OF OPERATION FOR REMOVAL OF THE HEAD OF THE PANCREAS AND DUODENUM

umbilicus. Ligature of the pyloric artery and of the gastro-duodenal artery. Section of the pylorus, or duodenum just below the pylorus. Division of the fascia along the right border of the duodenum. Posterior dissection of the second portion of the duodenum and the head of the pancreas.

Section of the duodenum at a point sufficiently far from the superior mesenteric vessels to protect them from injury. The dissection of the duodenum should be carried to a point

FIG. 26.
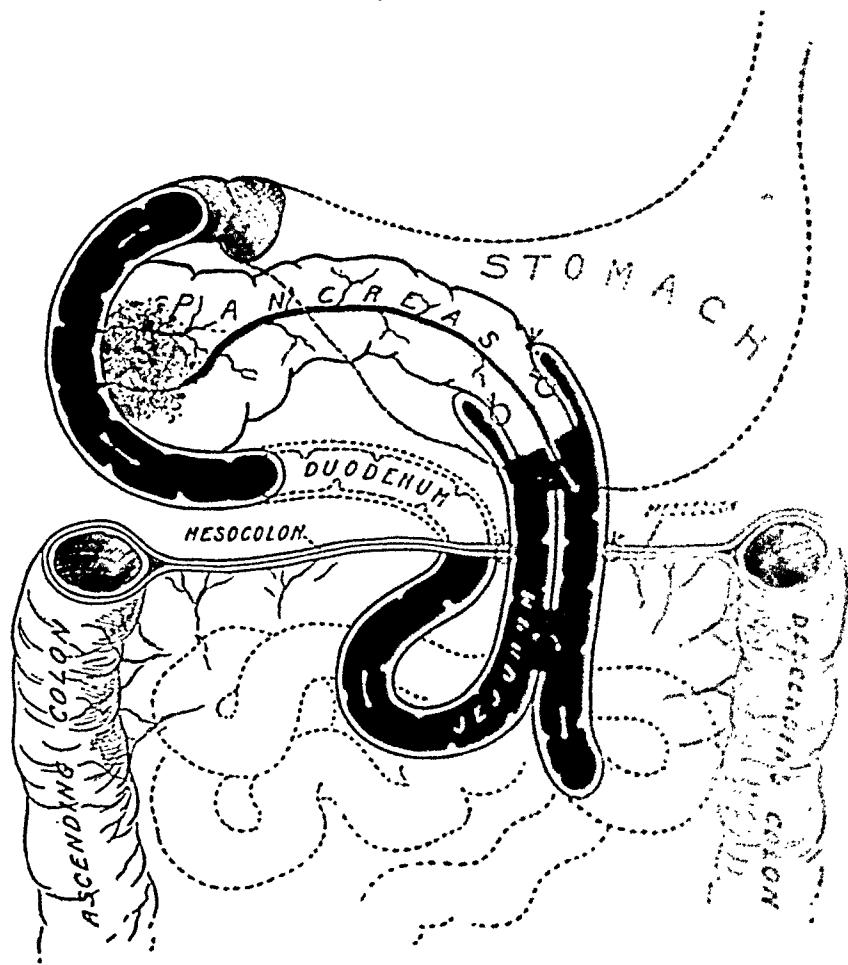
SCHEME OF PANCREATO-ENTEROSTOMY WITHOUT PANCREATECTOMY.

at which it can be easily separated from the head of the pancreas, but not to the mesenteric vessels. Ligation below of the pancreato-duodenal vessels. Section of the duodenum and suture of its lower end.

Separation of the " lesser " pancreas from the mesenteric vessels which cross in front of this portion.

Separation of the pancreas from the portal vein. Section of the head of the pancreas. Ligation and division of the common bile duct and division of the gastroduodenal artery, and the portions of the duodenum and pancreas are thus removed.

Now the cut end of the bile duct and the cut end of the stomach or duodenum, as the case may be, are held in clamps and the cut end of the pancreas wrapped in gauze awaiting implantation into the loop of jejunum.

Second step: If the gastrocolic omentum has not already been severed to permit a good exposure for work, it may now be done. An opening is made through the transverse mesocolon near its root, through which a loop of jejunum one or two feet in length is drawn. The pancreas is now implanted into the upper portion of this intestine,—lower down the stomach or duodenum is anastomosed, and still lower down the common bile duct is implanted. A few interrupted linen sutures fasten the intestine to the mesocolon as it passes up and down through the slit. These sutures also close the opening and prevent hernia (Fig. 25).

Pancreato-enterostomy without pancreatectomy (Fig. 26) may be done in the human as follows:

First, divide the gastrocolic omentum and loosen the tail of the pancreas by dissection and ligation of vessels.

Secondly, pick up a loop of jejunum as near to the ligament of Treitz as possible, and yet long enough to reach the tail of the pancreas with ease.

Thirdly, entero-enterostomy between the limbs of the loops.

Fourthly, make a hole through the mesocolon well to the left of the ligament and draw the loop of intestine through the opening.

Fifthly, strip and cut the duct of the tail of the pancreas and plant it into the loop by the method previously described in this paper. Fasten the intestine to the mesocolon where it passes in and down through the opening.

Sixthly, repair gastrocolic omentum.

independently from the mesentery to the umbilicus. Owing to the fact that the umbilical vessels empty into the mesenteric vessels, the cord containing the vessels always terminates at one end in the mesentery (Fig. 4) where its relation to the mesenteric vessels can be readily traced even in adult life.

Varieties of Persistent Umbilical Duct or Vessels.—The following conditions may exist after birth:

1. A complete canal opening at the umbilicus at one end and into the ileum at the other—comparatively rare. (Fig. 5A.)

2. A canal opening at the umbilicus but ending blindly at a variable distance within the abdominal cavity.

FIG. 1.
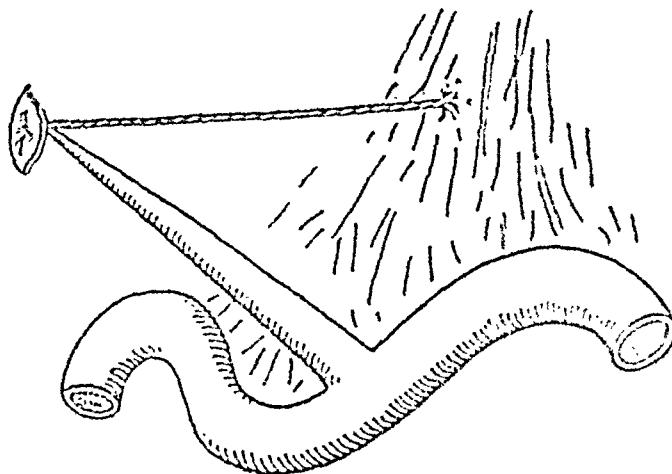
Meckel's diverticulum and vascular cord attached separately to the umbilicus.

3. An intermediate portion of the duct remains, having no communication externally at the umbilicus or internally into the gut, but forming a cystoma due to retention or secretion. Such a cystoma may have a ligament attaching it to the gut (Fig. 6).

4. The tube is limited to the proximal end of the canal opening into the ileum (Fig. 7). This is the variety generally known as Meckel's diverticulum, because Meckel [2] in 1812 was the first to direct attention to its importance as the cause of various pathological conditions after birth. Its existence had been known and it had been accurately described by others, but Meckel was the first to describe it accurately and show its relation to umbilical fistula and intestinal obstruction.

5. The cord containing the umbilical vessels may persist as

43

an independent structure and be attached to the umbilicus separately (Fig. 3). As was stated above, this vascular cord may either take an independent course or the vessels run along the free border of the mesenteriolum of the diverticulum, or finally—and this is a very frequent condition—they may run from the tip of the diverticulum and form a cord commonly known as the terminal ligament, whose points of attachment will be mentioned below.

FIG. 3.
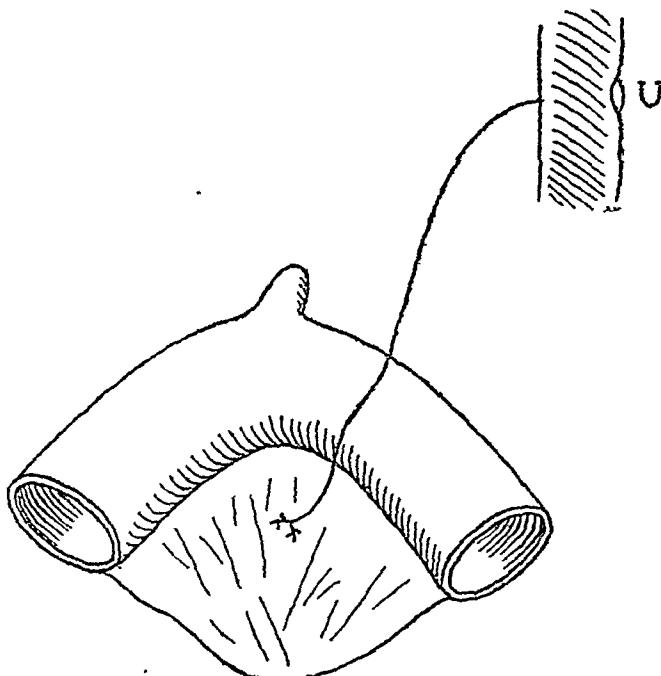
Persistence of the vascular (omphalomesenteric vessels) cord from the mesentery to the umbilicus, with rudimentary diverticulum.(Wilms).

6. The diverticulum may be either absent or very rudimentary (Fig. 3), and the only evidence of the presence of a congenital condition be a cord (containing the umbilical vessels or traces of them) extending from the mesentery to the umbilicus.

Attachments of the Terminal Ligament or Vascular Cord.—The fibrous cord or band by which the diverticulum is attached either to the umbilicus or some other structure is called the terminal ligament. This, as has just been explained, may represent the remains of the umbilical vessels which accompany the diverticulum. The normal point of fixation of the diverticulum or of its terminal ligament (which represents the obliterated portion

Fig. 2.
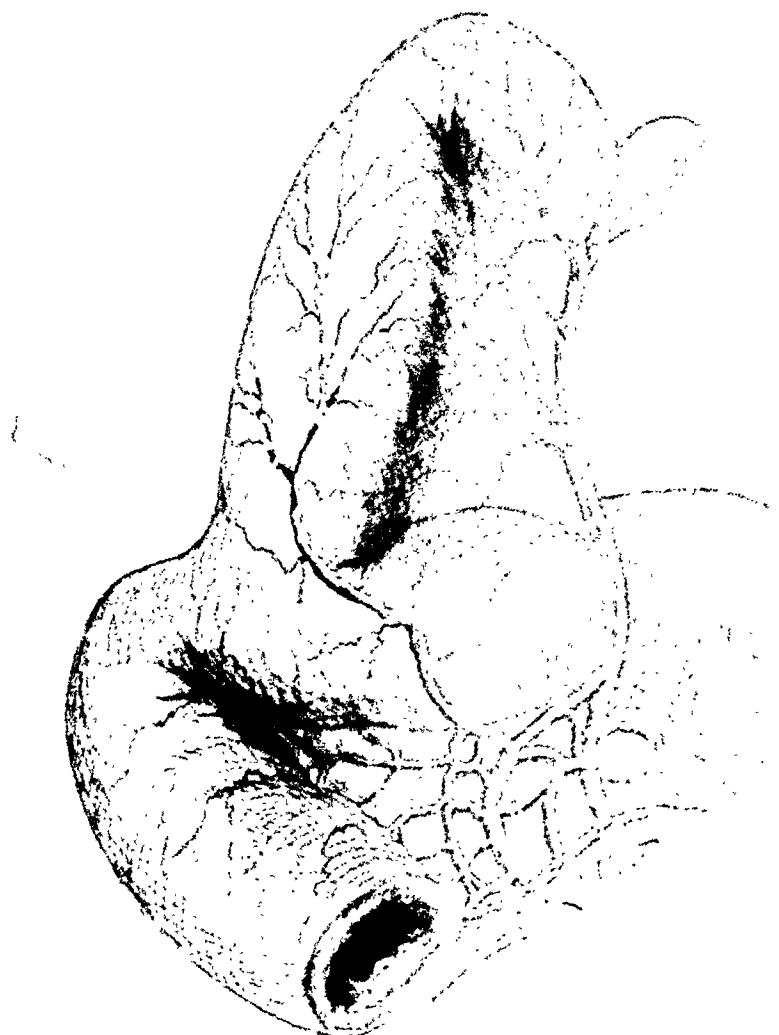
Fig 4

Strangulated Meckel's diverticulum complicating strangulation of intestine in narrow diverticular ring (Bostrom). Note the large ring formed by the diverticulum and its terminal ligament, the latter containing persistent omphalomesenteric vessels which empty into the mesenteric artery and vein respectively

of the diverticulum or its accompanying vessels) is at the umbilicus. The frequency of this attachment to the umbilicus varies somewhat according to various authors: e.g., Ketteler,[3] 21 in 89 cases; Halstead,[4] 15 in 69 cases; Treves,[5] 7 in 20 cases; Cazin,[6] 3 in 23 cases; and Newman,[7] 13 in 66 cases.

If the terminal ligament separates from the umbilicus it may attach itself at almost any portion of the abdominal cavity. The various points of attachment of the diverticulum or its terminal ligament are best shown in the accompanying figures of Ketteler[3] quoted from Wilms[8]: Mesentery 34, umbilicus 21, anterior abdominal wall 6, posterior abdominal wall 4, pelvis 5, bladder 2,

FIG. 5.
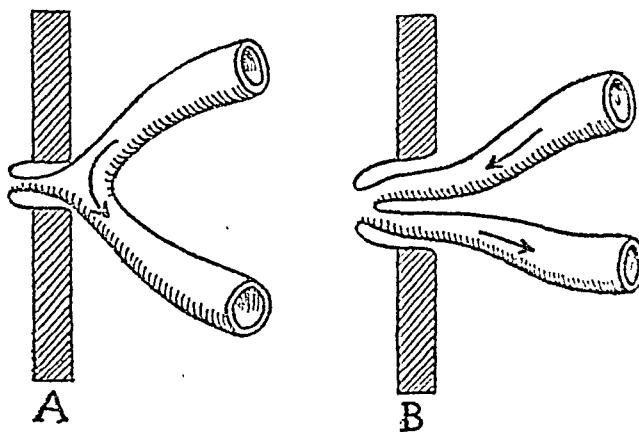
A, marked prolapse of open diverticulum at umbilicus without disturbance in passage of bowel contents. B, prolapse (evagination) of diverticulum causing ileus (Wilms).

cæcum and appendix 2, small intestine 11, large intestine 1, appendix epiploicæ of sigmoid 1, internal abdominal ring 1, intestine, omentum and abdominal wall combined (Fig. 1)—making a total of 89. Four cases are quoted by Neumann in which a vascular cord alone was present without any diverticulum. One can prove such a cord to be of non-inflammatory origin by demonstrating the vessels within its structure.

The insertions of the diverticulum or its terminal ligament were found by Hilgenreiner[9] to be as follows in 121 cases: Mesentery 47, umbilicus 34, ileum 11, anterior abdominal wall 0, posterior abdominal wall 4, pelvis 4, colon, cæcum, appendix and abdominal wall 8, internal ring, bladder, urachus and omentum 4.

Point of Origin. Frequency.—Hilgenreiner[9] has collected 62 cases and found that the diverticulum arose between 20 and 100 centimetres above the ileocæcal valve. As to the frequency of its occurrence it was found 90 times in 4848 autopsies, *i.e.,* about 2 per cent. It has been found more often in males than in females, in the proportion of 86 to 14.

Form, Length and Frequency.—The usual form of the diverticulum is a cylindrical one with a conical tip, which is usually

FIG. 6.
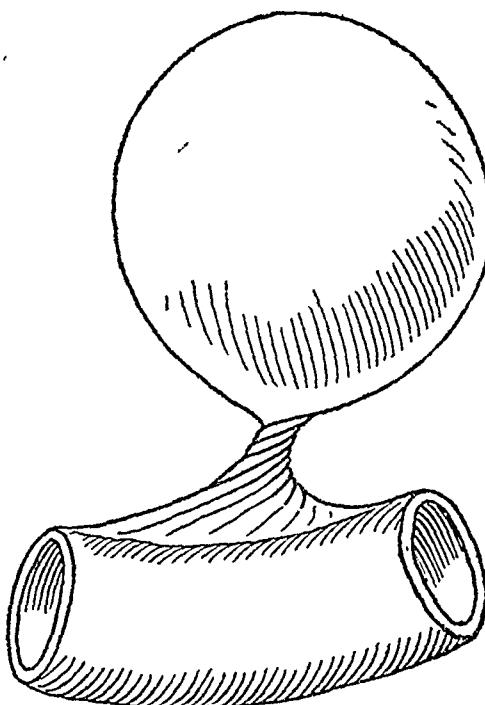
Volvulus of a diverticulum which has been converted into a retention cyst or enterocystoma (Roth's case).

free. The diverticulum usually arises from the convex surface of the gut, opposite the mesenteric attachment (antimesenteric border), but it may be nearer the mesentery. The average length given by Leichtenstern[10] is from 5 to 10 centimetres, while the length found by Huntington[11] was from 1.5 to 15 centimetres. It usually leaves the gut at a right angle, seldom at an acute angle, and it may have a mesentery of varying length. The point of origin from the intestine varies from 2 to 3 feet above the ileocæcal valve.

Fig. 7.
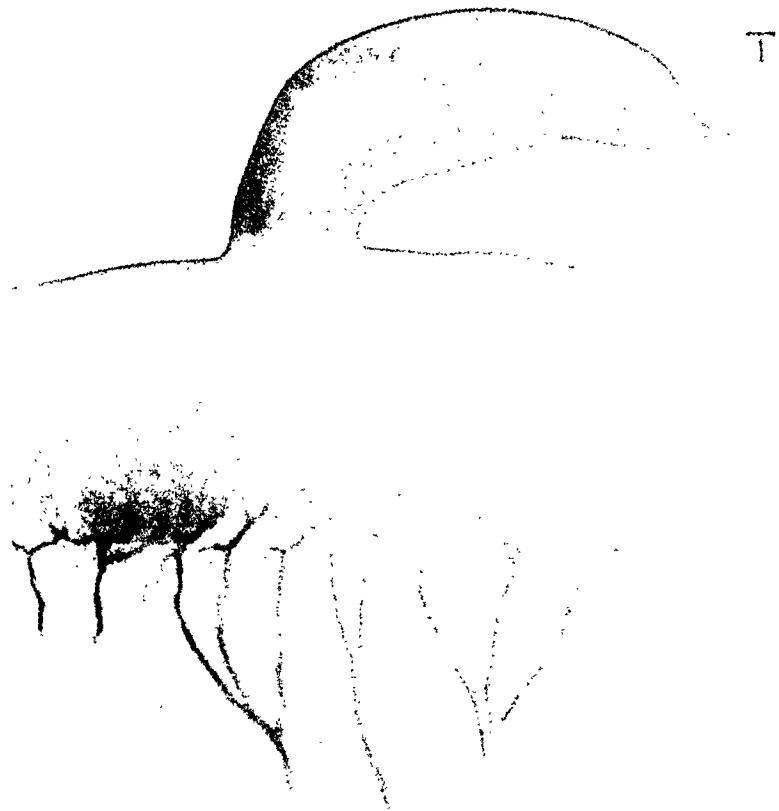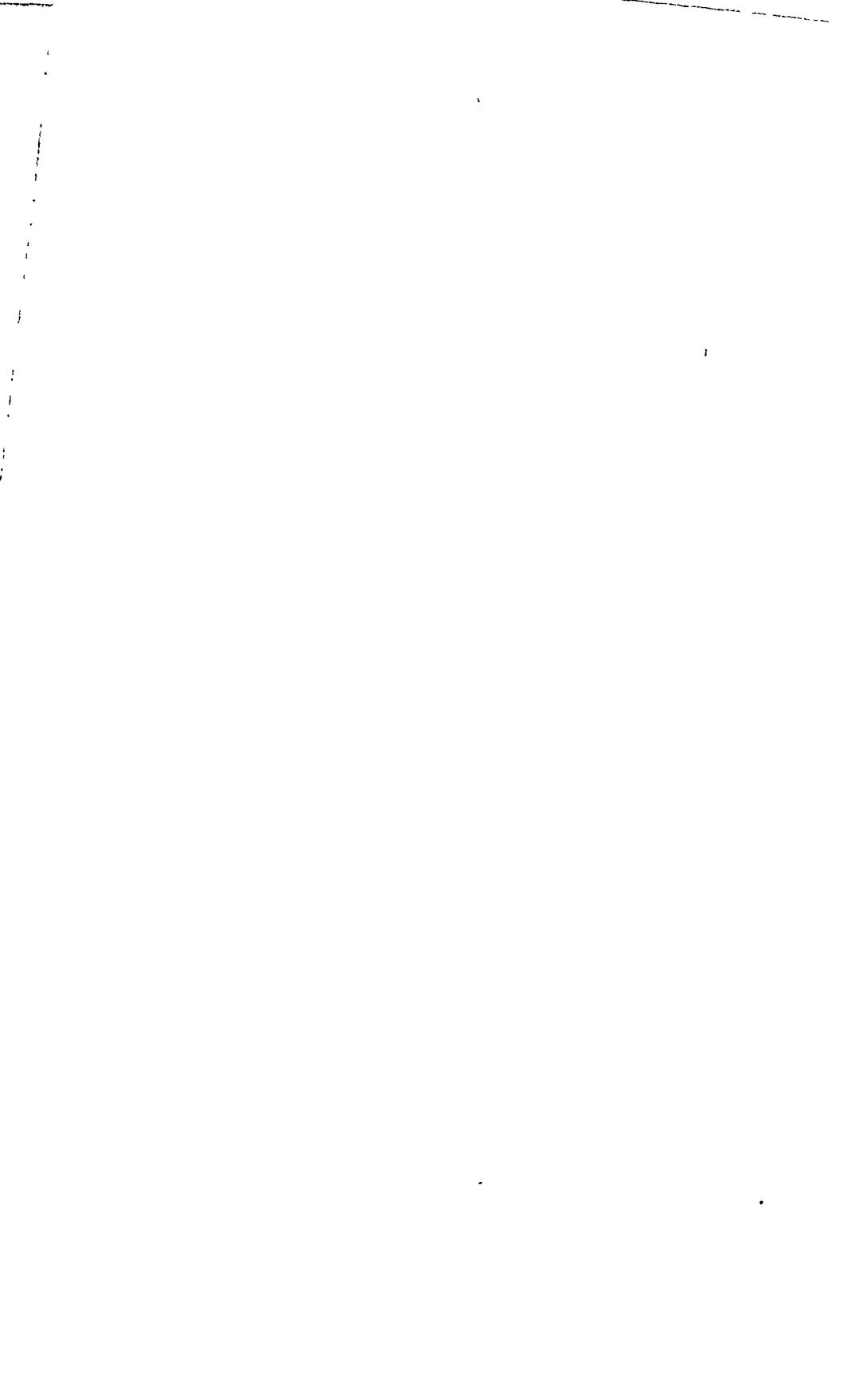
MECHANISM OF ILEUS DUE TO MECKEL'S DIVERTICULUM.

Certain of the anatomical conditions just described and some additional ones play an important rôle in determining the particular form or method by which ileus results from Meckel's diverticulum. These factors are:

1. *The Size and Contents of the Diverticulum.*—The diverticulum has been found to vary in size from that of a lead

FIG. 8.
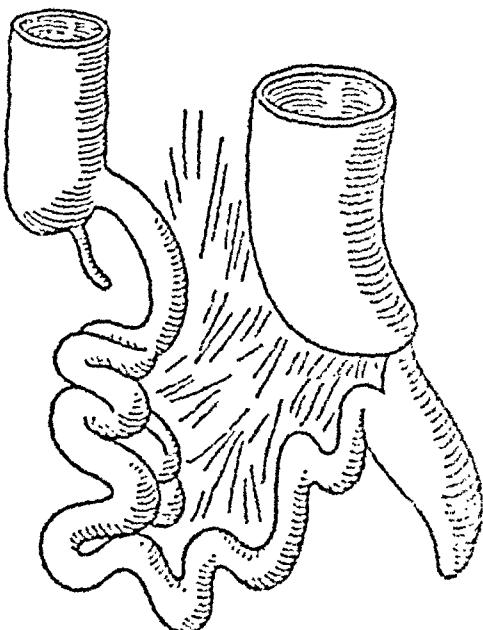
Stenosis of intestine at insertion of Meckel's diverticulum causing ileus (Gerd's case)

pencil to that of the gut.—in some instances even larger (adult head). It can readily be understood how a large diverticulum can compress a loop of gut and produce obstruction, especially if the contents are solid when the diverticulum is filled. Such an obstruction may be valve-like, depending upon the ability of the diverticulum to empty itself, so that there is a history of frequent recurrence of the attacks of obstruction.

2. *The Length and Form of the Diverticulum.*—These are of importance in understanding several of the modes of pro-

duction of ileus, *e.g.*, knot formation and volvulus. If the diverticulum is free and long the chances of knot formation are very great. As will be explained later, the knot is in all probability preformed and acts in a passive manner in catching the loop of intestine (Fig. 10). As a rule, knot formation is only possible when the diverticulum is long and slender, with a knob-like or ampullar end (Figs. 10 and 11). The distal enlargement is the result of stagnation and retention of contents in a long, free diverticulum, following obstruction to the outflow of its contents.

FIG. 9.
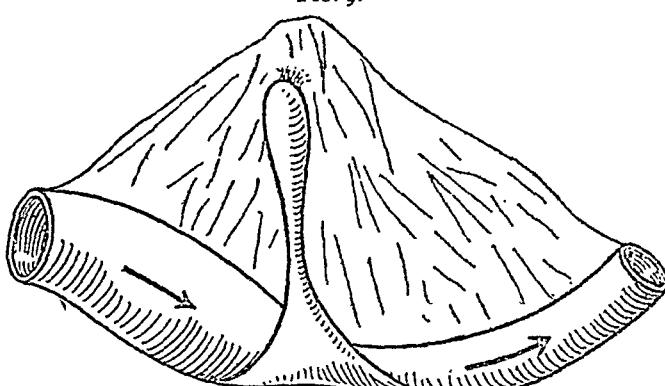
Ileus due to kinking of gut following traction of an adherent diverticulum (Hansemann's case).

3. *The Point of Insertion of the Diverticulum.*—If the diverticulum arises from some point nearer the mesenteric attachment than the middle of the convex border, a full or a short fixed diverticulum can readily cause a stenosis of the gut by traction (Fig. 8). If it arises (as rarely happens) within the layers of the mesentery, a stenosis readily follows repeated ulceration with subsequent cicatrization (Fig. 8).

4. *Whether the Diverticulum is Attached or Free.*—If it is free, obstruction depends as explained above upon its length, form, size and mode of origin from the gut. Intussusception is also more likely to occur in a free diverticulum. If the diverticulum is attached, obstruction is dependent (*a*) upon the point of attachment; (*b*) whether the diverticulum and its terminal ligament form a ring and whether this ring be large or small.

Every author who has written upon the subject of ileus

due to Meckel's diverticulum has proposed a classification of
his own of the mechanism. Some have based their classifica-
tion upon the question of whether the diverticulum is fixed or
free, *i.e.*, attached or not attached. Halstead,[4] for example, in
his article upon ileus due to Meckel's diverticulum, divides the
mechanism into two such large groups as follows: 1. Free
diverticulum divided into (*a*) knot formation; (*b*) kinking
of the intestine; (*c*) volvulus of the intestine; (*d*) stenosis

Fig. 10.
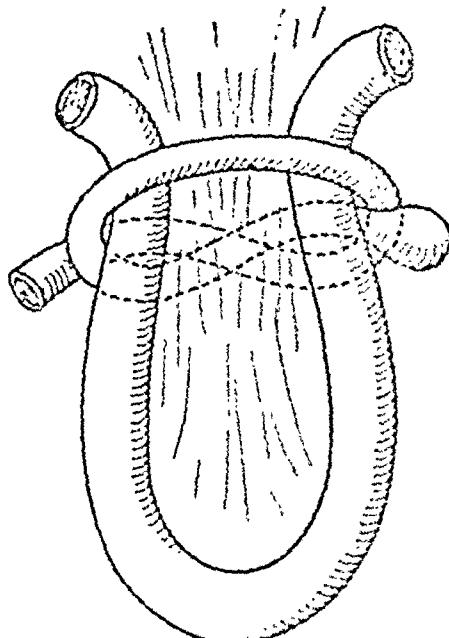
Knot formation by Meckel's diverticulum.

of the intestine; (*e*) evagination. 2. Adherent diverticulum
divided into (*a*) strangulation by band; (*b*) volvulus beneath
a band; (*c*) volvulus of the diverticulum.

This division although convenient, is not exhaustive enough
for the reason that the same mode of production of intestinal
obstruction may occur in both a fixed and free diverticulum.
Hilgenreiner[2] proposed a classification based upon the cases
of Meckel's ileus which he collected. In the following tables
lists I will give the classification of Hilgenreiner[2] and
Wilms,[10] and in order to assist in understanding the various

mechanisms, I have added a number of illustrations from Wilms' book. The numerals after each variety in the Hilgenreiner table represent the number of cases of each group, *i.e.*, the frequency of the various mechanisms in his series of 180 cases. The grouping which has seemed to the writer to be the most logical and exhaustive one is that suggested by Wilms, and I have adopted it in this paper as the basis of the discussion of the various ways in which ileus can be produced by Meckel's diverticulum.

As Wilms correctly says: " A clinical classification would be far more practical than a pathological one, but it is almost impossible to make one based on such a basis." The grouping of Hilgenreiner [9] and Wilms [8] is as follows:

HILGENREINER.		WILMS.	
1. Evagination	9	1. Evagination	Fig. 5
2. Invagination (intussusception)	12	2. Invagination (intussusception).	
3. Strangulation and volvulus of diverticulum	5	3. Volvulus of diverticulum, with or without secondary volvulus of the gut	Figs. 6. 18
4. Stenosis of the intestine....	2	4. Stenosis of intestine at point of attachment of diverticulum	Fig. 8
5. Kinking of intestine	19	5. Broad compression and kinking of the intestine from traction of the fixed and free diverticulum	Fig. 9
6. Compression of intestine...	5	6. Included under 5 above.	
7. Knot formation	11	7. Knot formation	Figs. 10, 11
8. Volvulus of the intestine...	11	8. Included under 3 above.	
9. Inflammatory closure	7	9. Included under 4 above.	
10. Strangulation by a fixed diverticulum	96	10. Strangulation in a narrow or wide diverticulum ring	Figs. 12, 13, 14
	180	11. Kinking of gut across a diverticular cord or in a ring	Fig. 15
		12. Combination of volvulus and kinking by a diverticular ring or cord	Fig. 16

.From the above it will at once be seen that the mechanism of ileus due to Meckel's diverticulum is far from being a

simple matter. No single mode of production holds true for all cases, and it is only after a careful study of the subject that one can have a clear conception of the more complicated forms.

Evagination of the Open Diverticulum.—The first evidence that a diverticulum remains as an open tube adherent to the umbilicus shows itself about four to five days after birth (as soon as the umbilical cord has sloughed). If the external opening is large, fæces escape; if it is quite minute only mucus is discharged. If the gut wall pushes itself like a spur into

Fig. 11.
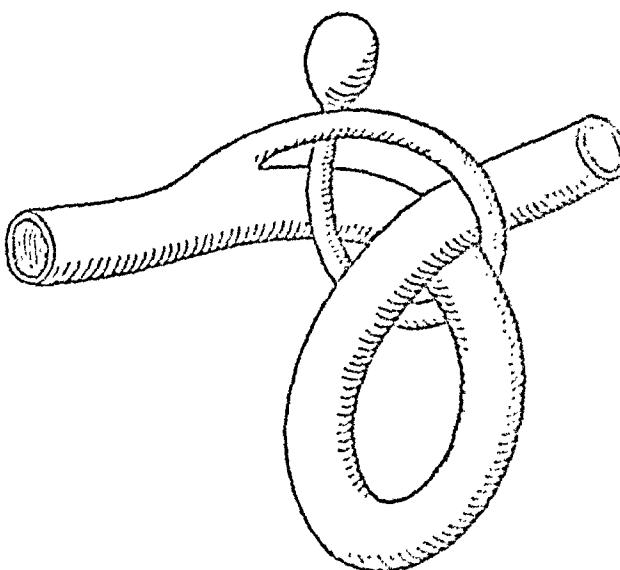
Ileus due to coil of intestine distal to insertion of diverticulum of gut in a sort of knot (Heller's case).

the diverticulum (Fig. 5) to an obstruction occurs and the sympto: Of the seven cases of this variety c

If the normal obliterative chang interfered with it may (*a*) remain at the intestinal end or at both, c may persist and develop into cystic character. The manner in which st ticulum can produce ileus through is referred to later (see broad con:

diverticulum and kinking of the gut by traction of the diverticulum). Such an enterocystoma is found lying free within the abdominal cavity, remaining attached to the gut only by a cord (Fig. 6), the cyst itself often gravitating to the pelvis.

Intussusception of Meckel's Diverticulum.—Only twelve cases are reported of this mode of production of ileus. There are two varieties, (*a*) invagination of the diverticulum alone, or (*b*) invagination of the diverticulum and gut. Undoubtedly the majority are the result of the effort at expulsion of

FIG. 12.
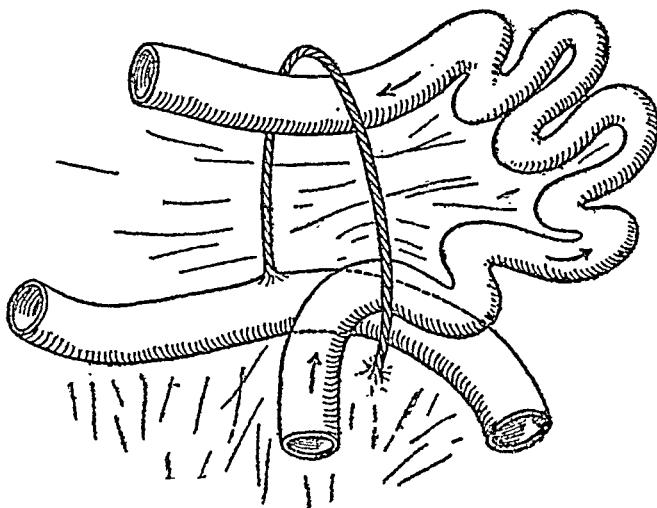
Narrow diverticular ring (Wilms) causing strangulation of gut. The diverticulum is almost completely obliterated and the ring is chiefly formed by the vascular cord.

some foreign body from the diverticulum. The clinical signs are like those of ordinary intussusception, viz., a sausage-shaped tumor, blood in the stools, vomiting and collapse.

Volvulus of the Diverticulum and Possible Secondary Volvulus of the Gut.—As a rule, the diverticulum acts in a passive manner in the production of all of the different varieties of ileus due to it. A volvulus of the diverticulum is not uncommon, the causes varying somewhat. In a free diverticulum its weight and size play a role, the lighter intestine being able to change its position more readily than a heavy free diverticulum, so that the latter may become rotated upon its axis. The same holds true for the fixed diverticulum, the variation

in the amount of gas and fluid within it causing a change in its position, with resultant torsion at the point of insertion into the gut (Fig. 18). The volvulus of the diverticulum may only be accompanied by the signs of an acute diverticulitis, viz., pain, rigidity, nausea and gradual onset of the signs of peritonitis. As a rule, if recovery ensues without operation, adhesions form which encroach upon the lumen of the gut. The symptoms of ileus may, however, appear in an acute man-

Fig. 13.
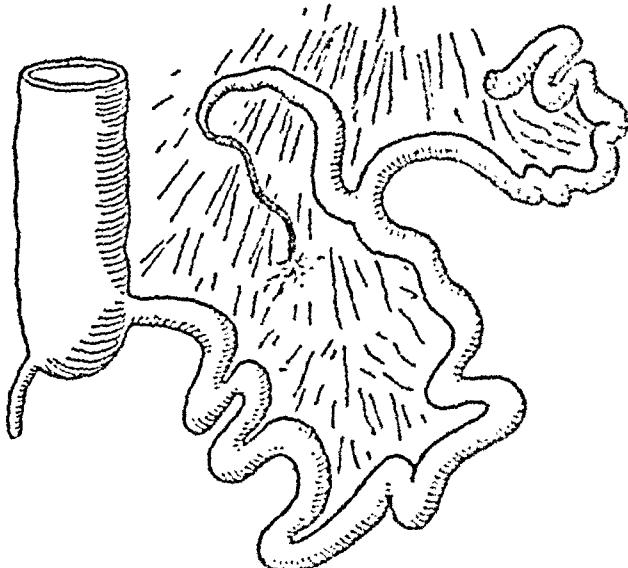
Wide diverticular ring (Wilms).

constriction, because the diverticulum is a portion of the gut itself and possesses all of its properties, viz., gangrene, perforation, volvulus formation, etc. Gangrene of the diverticulum may be found in Meckel's ileus when (*a*) the diverticulum undergoes rotation; (*b*) it is compressed by a coil of gut which has become strangulated beneath a fixed diverticulum, or (*c*) by a loop of gut suspended across it (Fig. 4), or (*d*) by traction. The sequelæ of such a necrosis of the diver-

FIG. 14.
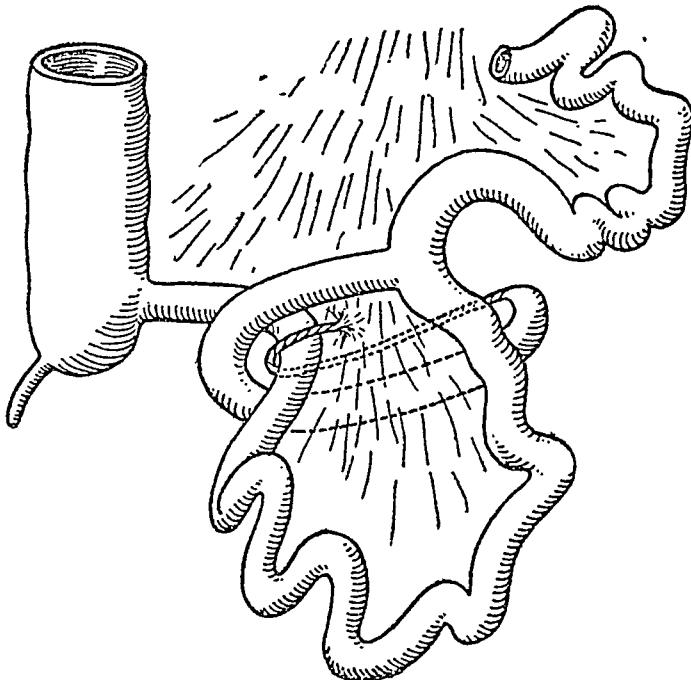
Strangulation in a narrow diverticular ring (Wilms). The ring was quite large at first, but as a result of the slipping of one coil below and one above the diverticulum, the wide ring becomes converted into two narrow ones.

ticulum are either adhesions, abscess formation or perforation with general peritonitis.

Stenosis of the Intestine.—This is best explained by assuming that the diminution of the size of the lumen or its complete obliteration, which usually occurs above the insertion of the diverticulum, is the result of repeated injury of the diverticulum followed by ulceration and cicatrization of the gut in the vicinity of the diverticulum. Treves has called attention to the manner in which such damage occurs. When a large

free diverticulum is full it cannot follow the movements of the intestines, so that the latter exert traction upon the point of insertion of the diverticulum, leading to abnormal kinking, so that the fecal current is slowed, leading gradually to ulceration and stenosis (Fig. 8).

Broad Compression of the Gut by the Diverticulum and Kinking of the Gut Due to Traction of the Diverticulum.— Cases of broad compression are quite rare, the case of cysterna (Fig. 6) described under evagination which compresses the intestine belonging to this class.

FIG. 15.
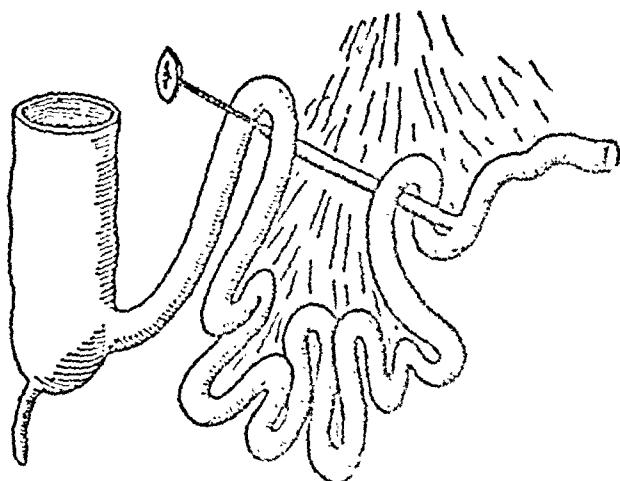
Ileus due to kinking of the intestine from traction upon an aberrant diverticulum (Wilms). Note how the afferent and efferent loops of the bowel hang over the diverticulum like a shawl carried upon the arm.

acutely filled the gut is easily kinked through traction of the
adherent diverticulum.

Knot Formation.—The three conditions which are essen-
tial in the production of knot formation by a Meckel's diver-
ticulum are (*a*) that it should be free, *i.e.*, non-attached; (*b*)
that its end be knob-like, *i.e.*, ampullar (Fig. 10), and (*c*)
that the diverticulum must be a long one. The mechanism
of the process of knot formation is best understood by a study
of Figs. 10 and 11. Some writers believe that the diver-
ticulum acts in an active manner like a rope, in whipping itself
around a loop of gut and ensnaring it. Other writers, and
these form the majority, think that the knot is preformed, *i.e.*,
it acts in a passive manner and the bowel slips into it. The
latter view is held by Leichtenstern and Wilms. At first only
a small portion of the gut is caught, but as the result of peri-
staltic action more of the intestine enters, and this does not
cease until the more fixed portion close to the cæcum checks
any further entry. There are but few genuine cases of true
knot formation on record. Figure 11 shows a typical case of
it reported by Regnault. Two cases of double knot formation
have been recorded. The clinical features of knot formation
are the rapid onset of ileus symptoms with fixed pain in the
right lower quadrant.

*Strangulation in a Diverticular Ring or by a Diverticular
Band.*—There are two types of fixed Meckel's diverticula.
The first form is where the diverticulum passes across the
peritoneal cavity as a cord, being composed partly of tissue
resembling that of the intestine and partly of tissue which
shows no traces of it, viz., connective tissue. This form is
shown in Fig. 12 and the various points of attachment, *e.g.*,
umbilicus, mesentery, etc., have been previously mentioned. In
the second form the diverticulum with its accompanying om-
phalomesenteric vessels forms a ring. (Figs. 2 and 20.)
In this second group the diverticulum may be either fixed or
free and the ring itself may be large or small (Figs. 4 and 13).

Strangulation in a Narrow or Wide Ring.—If an opening
exists in the diverticular ring, even though it is quite small,

a coil of intestine may slip through it,—in fact, a large, i.e. wide, ring is less apt to catch a coil of gut than a narrow one (Fig. 12).

In the case of a wide ring, the vessel cord and diverticulum become twisted in such a manner that a second or smaller ring is formed, though which strangulation occurs as shown in Fig. 4. This does not occur nearly as often as when the diverticulum and its vessel cord form a figure of eight.

Ileus Due to a Coil of Gut Being Kinked Across a Diverticular Cord or in a Diverticular Ring.—In this form of

Fig. 16.
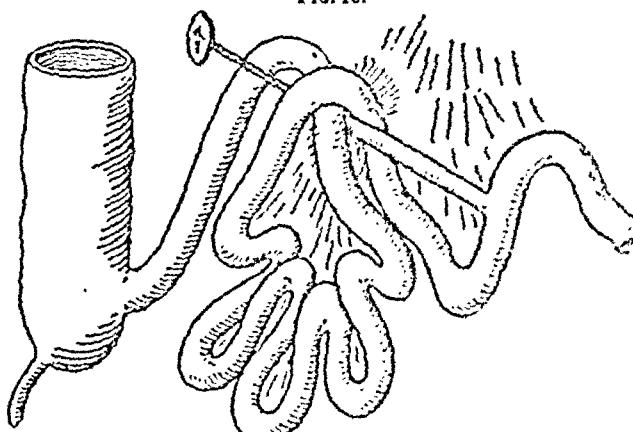
Ileus due (a) to kinking (the result of traction from a coil of gut and (b) to an attached diverticulum) and (b) to volvulus of the obstructed loop (Wilms).

Meckel's ileus the coils of intestine hang across the diverticular band like a shawl laid across an arm (Fig. 9). After obstruction takes place, more and more gut is pulled across until the caecum is reached.

peritonitis sets in early, due to gangrene of the diverticulum, as explained previously. The same form of ileus can exist in diverticular rings as in bands due to an adherent diverticulum.

In the case shown in Fig. 13 the ring had a large lumen. It was too wide to hold the loop of gut, but the latter may fall across the ring, becoming kinked, as in Fig. 15. Under these circumstances torsion may occur at the base of the diverticulum, with resultant necrosis or chronic inflammatory processes (the latter leading to stenosis of the gut). A terminal ligament alone may act like a diverticulum in causing kinking or strangulation.

If the gut is tightly caught beneath a band, as in the author's case (Fig. 20), the gut wall necrosis occurs far more slowly than does that of the diverticulum.

The writer's case belonged to the last named group, viz., strangulation beneath a narrow ring. The diverticulum itself showed quite advanced inflammatory changes, as will be seen from the drawing (Fig. 7), made very shortly after operation. The tip of the diverticulum was attached through its terminal ligament to the mesentery, and beneath this ring two coils of ileum had become strangulated. The history of the case is as follows:

Sophie B., aged 22, married. Had always enjoyed good health until three months prior to the onset of the present illness. At that time she had an attack of "crampy" pain in the centre of the abdomen, with vomiting. · The pain and discomfort lasted three hours, but disappeared without any other symptoms developing. She had remained well until 27 hours before admission, when she began to have another attack of pain in the umbilical region. Six hours later she had an attack of vomiting which lasted ten minutes. There was no chill. The pain was distinctly localized at the umbilicus.

Upon admission to my service in the Michael Reese Hospital on May 27, 1909, examination revealed the following: The patient lay in bed with her knees drawn up. There were moderate abdominal distention and marked rigidity of both recti muscles, especially upon the right side.

Fig. 17.

Exquisite tenderness was present over the right lower abdominal quadrant, and upon moderate pressure the patient complained of pain in the umbilicus. The temperature (rectal) was 101; pulse 96. Bimanual vaginal examination was negative. Leucocyte count 19,200. On account of the well-localized rigid-

Fig. 18.
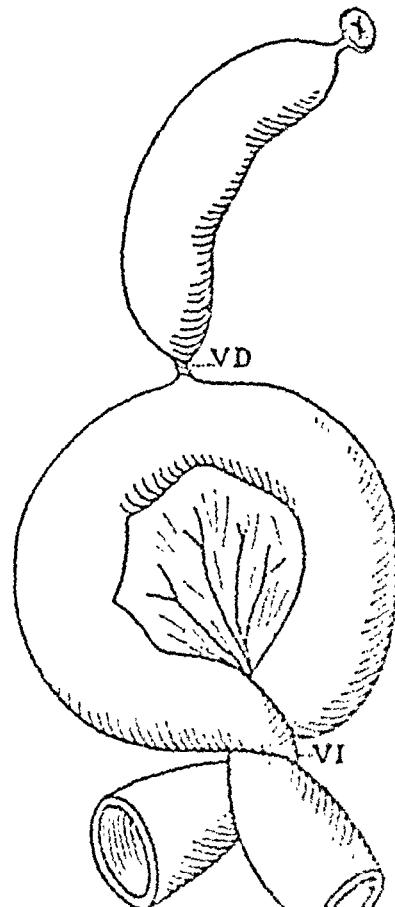
place with resulting general peritonitis. She had vomited for 18 hours prior to admission but did not vomit during her stay in the hospital prior to operation. Efforts to secure a bowel movement during her brief stay in the hospital (12 hours before operation) had been unsuccessful. Her temperature just before operation was 100 degrees; pulse 99.

Upon opening the peritoneal cavity, through a right rectus incision, a considerable quantity of clear serous fluid escaped.

The appendix was brought into the wound and found perfectly normal, with the exception of moderate injection of the vessels of the serosa. Upon retracting the edges of the incision, a number of coils of small intestine presented which were seen to be greatly distended, their serosa somewhat roughened and vessels markedly injected. From these appearances and the normal condition of the appendix, a search was made for the source of the supposed peritonitis.

Upon further examination of the presenting coils of small intestine, a number were found completely collapsed, so that it became evident that an obstruction must be present and that our previous diagnosis of beginning peritonitis was erroneous. The ileum was carefully inspected, beginning at the ileocæcal valve, and the cause of the ileus found to be an intensely congested, bluish-red Meckel's diverticulum (Figs. 7 and 20) situated about 60 cm. (24 inches) above the ileocæcal junction. This diverticulum was 8 cm. (3¼ inches) long and about 2 cm. wide at its base, tapering gradually toward its tip which was held firmly to the mesentery by a short terminal ligament. Several loops of ileum were strangulated beneath this ring, the portions distal to the constricting diverticulum being greatly distended and those upon the other side being collapsed (Fig. 20). The short terminal ligament was ligated and the coils of intestine released. The terminal ligament was divided between two ligatures and the strangulated loops released. Examination of the latter showed a distinct constriction ring which was of a grayish color, but evidently not deep enough to give rise to any danger of perforation, so that resection of the strangulated loops was deemed unnecessary. The diverticulum (Fig. 7) arose from the antimesenteric border of the gut and the ileum at the point of insertion was narrower than the portion above and below it. An incision was made around the base of the diverticulum and

the latter removed after ligation close to the base. The edges of the ileum were united by a double row of Lembert sutures. The serosa and mucosa of the diverticulum showed intense congestion, but unfortunately the specimen was placed in strong formalin solution soon after removal, so that it was impossible to make any satisfactory sections for microscopical study. The patient made an uneventful recovery and left the hospital two weeks after operation.

Fig. 19.
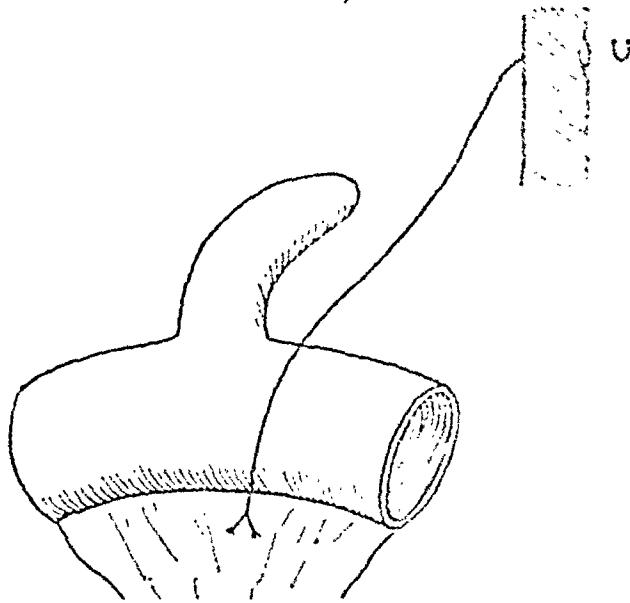
Separate free diverticulum and adherent vascular cord (Wolff's?) which is made up of the omphalomesenteric vessels runs separately up from the mesentery to the umbilicus, being attached to the umbilicus but the diverticulum itself is free.

The previous history, examination upon admission, and the operative findings show clearly that the attack three months previously was in all probability similar to the present one, but less complete and only transitory. The signs of intestinal obstruction were obscured by those of the diverticulitis, so that the diagnosis of appendicitis seemed a plausible one. The mechanism of the obstruction was of the type described as strangulation under an adherent diverticulum or by a diverticular cord (Fig. 12).

Symptoms and Diagnosis of Meckel's Ileus.—Unless one can obtain a history of an umbilical fistula which existed during infancy, but has healed, or an open diverticulum is still present, it is impossible to make a diagnosis of a Meckel's diverticulum being the specific cause of the ileus in a given case.

In every other respect than the two just mentioned (healed umbilical fistula or open diverticulum) *there are no signs which stamp this form of ileus from that due to any other cause.*

As a rule, the onset of the symptoms of obstruction is sudden, but in a number of cases there is, as in my own, the history of one or more previous attacks of ileus. As to age and sex, we have a little help in the fact that diverticular ileus occurs more frequently in men than in women, and most often during the first three decades.

In 138 cases Hilgenreiner found this cause of ileus in 113 men and 25 women, *i.e.*, 82 to 18. In 137 cases he found that more than two-thirds occurred in the first three decades, and of these the majority were between 15 and 25. It is quite rare above the age of 40.

In a number of cases the fact that the pains were referred to the umbilicus was thought to be of value in determining the cause of the ileus. But these umbilical pains are so constantly present in appendicitis that many cases like the writer's are erroneously diagnosed as appendicitis. In the section upon the mechanism of this form of ileus attention was called to the fact that the condition of the diverticulum itself must be taken

FIG. 20.
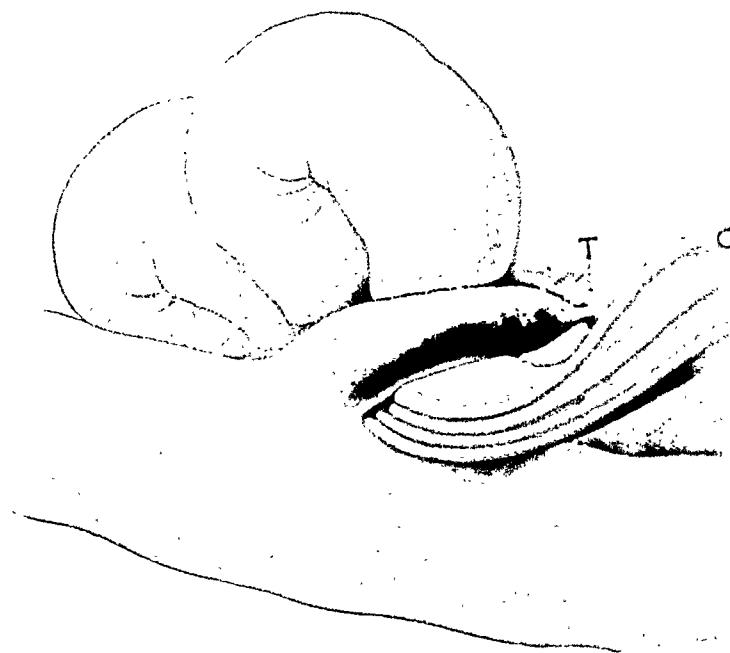
Strangulation of two coils of ileum beneath an attached Meckel's diverticulum. T, terminal ligament attached to mesentery. C, collapsed coils of ileum (terminal ileum).

into consideration in every case of ileus due to this cause. The diverticulitis so often accompanying these cases will cause the same symptoms, viz., localized pain, rigidity, tenderness, leucocytosis, fever, etc., as a genuine appendicitis and thus obscure the clinical picture until the symptoms of ileus—whether of the obturation or strangulation type—become more prominent and finally predominate.

The signs of intestinal obstruction do not differ from those which are due to other causes than Meckel's diverticulum In some the course is somewhat protracted, varying with the degree of obstruction. In other cases the course is of the fulminating type, the vomiting, abdominal distention, obstipation, etc., following each other very rapidly. If a stenosis of the gut due to a stricture be the cause of the obstruction, the symptoms are very slow in their onset, the repeated colics, occasional vomiting, visible peristalsis and obstinate constipation differing but little from the clinical picture as seen in other cases of enterostenosis of the more chronic type. When the abdomen has been opened the diagnosis becomes a much simpler problem, as a rule. There are, however, cases in which repeated attacks have given rise to such dense adhesions that it is difficult at first to determine the cause of the obstruction.

The surgeon should be thoroughly familiar with the various modes of obstruction caused by Meckel's diverticulum in order to properly correct the condition underlying the ileus

Treatment.—Ileus due to Meckel's diverticulum is equally as clear an indication for operation as that due to any other cause, e.g., volvulus, strangulation by a band or aperture, intussusception, etc. The operative technic differs in only a few minor details from that employed in the treatment of other forms of intestinal obstruction, and in this connection I cannot too strongly emphasize the importance of early operation and of an accurate knowledge of the various modes of production of ileus due to Meckel's diverticulum.

The best incision for all varieties of ileus is one in the median line below the umbilicus. Undoubtedly many cases

are operated upon, as in the writer's case, for a supposed appendicitis through a right rectus incision, and this may be a fortunate error.

If one suspects a Meckel's diverticulum before the operation as the cause of the ileus, the right rectus incision is a very convenient one, since it permits a rapid survey to be made of the lower ileum. No hard and fast rules can be laid down as to the operative technic in cases of ileus in general, and of this variety in particular. Much depends upon the length of time which has elapsed since the obstruction was complete. The amount of distention of the coils of intestine, the condition of the strangulated or obturated coil or coils in regard to gangrene, etc., and, finally, the general condition of the patient, are all additional factors which influence the methods to be employed.

In general, it may be said of this as of the other forms of ileus, that the more conservative the procedure if the patient's condition is bad, and the more rapidly the operation is performed, the better will be the result.

A certain routine is necessary after opening the abdomen. In cases of ileus of the variety described in this paper the lower ileum is usually found collapsed, so that search should be begun for such empty coils at the ileocæcal valve and the gut passed rapidly through the fingers until the point of obstruction is reached. As few coils of intestine as possible should be brought out of the abdominal incision. It would seem to be superfluous to mention this, were it not for the fact that operators are apt to underestimate the amount of shock resulting from prolonged exposure and handling of coils of intestines, even when covered with hot towels. A minimum degree of eventration is easily attained if coils are returned into the peritoneal cavity as soon as they have been inspected. As soon as the cause of the obstruction has been found in the form of a diverticulum or a vascular cord, the attachments to the mesentery (Fig. 20) or to some other structure, e.g. umbilicus, etc., should be severed between double ligatures.

If the diverticulum is free this step is of course unnecessary. After ligating the terminal ligament in an attached diverticulum, the latter is removed by making an incision around its base close to the junction with the ileum through the serous coat, as was done in the writer's case, and ligating it without permitting bowel contents to escape. The opening in the ileum is now closed either by a purse-string suture of silk, reinforced by a row of Lembert sutures, or—as some prefer—a double row of Lembert sutures.

The treatment of the complicated forms and sequelæ of a Meckel's ileus does not differ from that incident to any other cause of ileus. If the coil of intestine is gangrenous as the result of the circular constriction within a diverticular ring (Fig. 20), resection is indicated, if the condition of the patient warrants such a step.

If, however, the coils of intestine are distended and the general condition is not good, an enterostomy is the safest procedure. This temporary fistula can be readily closed or the gut at this point resected when the patient has recovered from the immediate effects of the toxæmia due to the ileus. The method of resection is largely a matter of choice, but the writer prefers the suture method rather than the use of any device.

What has just been said of lation within a ring, knot, etc. forms of obstruction due to occl gulation. In other words, afte or vascular cord have been sev the question of resection, enteros the condition of the gut and of

The general tendency of the present time is toward an ente if the patient's condition is not s cal measures. In regard to the due to Meckel's diverticulum, s ber of cases are of little value.

day of the obstruction and the variety of ileus (obturation or strangulation) as well as upon the judgment of the operator.

BIBLIOGRAPHY.

[1] Piersol: Text-book of Anatomy.
[2] Meckel: Handbuch der pathol. Anatomie, 1812.
[3] Ketteler: Dissertation, Göttingen, 1900.
[4] Halstead: ANNALS OF SURGERY, vol. xxxviii.
[5] Treves: Intestinal Obstruction, London, 1884.
[6] Cazin: Archiv für klinische Chirurgie, vol. xxx.
[7] Newman: Virchow Festschrift, 1891.
[8] Wilms: Der Ileus—Lieferung 46 g. deutsche Chirurgie.
[9] Hilgenreiner: Beiträge zur klinischen Chirurgie, vol. xxxii.
[10] Leichtenstern: Ziemmsen's Handbuch, Band vii.
[11] Huntington: Anatomy of the Peritoneum and Abdomen.

DIFFUSE PERITONITIS.*

But far more important from our standpoint, than either the extent or minute structure of the peritoneum, is its remarkable power of absorption. It is quite immaterial for our purposes to decide whether this be primarily through the vascular system or by means of the lymphatics. It is this absorptive power or action of the peritoneum which renders infection of that membrane so dangerous to the organism as a whole. Moreover, foreign bodies—and especially bacteria—are taken up in great quantities by the peritoneum in an incredibly short time.

The absorptive power of the peritoneum is not uniform throughout. It has been demonstrated that the diaphragmatic area absorbs most rapidly and the omental area stands next in this respect. The parietal and visceral areas play an entirely secondary rôle in absorption. The pelvic zone is the least absorptive of all, thus accounting for the comparative ease with which infections in this area, as those arising from the tubes and ovaries in the female, are withstood.

Murphy in his recent article on peritonitis has called particular attention to the influence of the mechanical action of the diaphragm in promoting absorption through the peritoneal surface covering it, and has compared the suction excited by the opening and closing of its lymphatics to the action of a pump. Such a supposition would help us to explain the very great absorptive power in this region.

The whole clinical picture and course of acute peritoneal infection or acute peritonitis depends upon this absorptive power of the peritoneum. It is impossible to conceive of any lesion in which the discrepancy between the constitutional symptoms and the immediate damage locally is greater.

For practical purposes we may say that peritonitis is always caused by bacteria. Simple mechanical peritonitis is largely of academic interest, while the existence of a special form of aseptic chemical peritonitis, aside from that caused by experimental introduction of irritant solutions or the rare escape of sterile physiological fluids into the abdominal cavity, is no longer considered as playing any part.

ance what results come from the bacterial invasion. He found that the presence of even such mild fluids as normal salt solution or sterile bouillon in the abdominal cavity was sufficient to excite an invasion by bacteria subsequently injected into a vein.

Occasionally we encounter clinical instances of peritonitis in which we can find no intra-abdominal lesion or portal of entry, and we are forced to conclude that the infection was hæmatogenous in origin. In the cases of primary pneumococcus peritonitis which have multiplied so rapidly of late, the causal organism certainly gained entrance in many instances through the blood from a distant pneumococcus infection such as pneumonia, otitis media, etc.

From a practical standpoint, however, this avenue of infection fades into insignificance when compared with (fourthly) peritonitis derived by direct infection from diseased intra-abdominal organs. The appendix, the pyloric region, the internal genitalia of the female and the gall-bladder are responsible for over 95 per cent. of all cases of peritonitis, and it is the knowledge of this fact which more than anything else gives us a substantial basis for diagnosis and treatment.

The bacteria which can excite a peritonitis are numerous, but ordinarily we find certain organisms recurring with great regularity. The colon bacillus is by far the most common, though its ability to overgrow other organisms in culture media doubtless gives it a statistical importance beyond its deserts. A smear from the pus will often reveal the presence of a mixed infection even where it is impossible to isolate by culture any organism except the colon bacillus. Pfeiffer, working in the laboratories of the German Hospital, by culturing the surface of actively inflamed appendices in an early stage has found a considerable percentage showing the pyogenic cocci, albus, citreus and aureus. Later, through the portal of entry thus made, the ubiquitous colon bacillus makes its appearance and often assumes a leading part.

Dudgeon and Sargent ascribe a special importance to the

staphylococcus albus, having found it the first to appear and the last to disappear in peritonitis. They found it in the early stages of diffuse peritonitis and in the region about the advancing edge of more severe infections. They recovered it from the clot in practically all cases of intra-abdominal hemorrhage and from the surface of the bowel in many cases of intestinal obstruction. From the findings combined with the results of experimental work they assert that the staphylococcus albus is practically nonpathogenic under these conditions, and, indeed, exercises a protective function by inducing a mild antecedent inflammation of the peritoneum which better enables it to withstand the attack of subsequently arriving organisms of higher virulence. We have been unable to find the white coccus with such regularity, but our observations are as yet too few to be conclusive.

Murphy names the organisms of most importance in accordance with their order as follows: The colon bacillus, the streptococcus, the pneumococcus, the bacillus pyocyaneus, the typhoid bacillus, the gonococcus and the staphylococcus pyogenes aureus.

The streptococcus is relatively more important in women than in men on account of the frequency of the streptococcic infections of the pelvic organs. T
18 times in 41 cases of diffuse per
peculiar difficulty of isolating thi
cultures undoubtedly fails to give
quency. Pfeiffer has repeatedly se
in stained smears from peritoneal c
ing search failed to reveal them in
culture or in puerperal infections
ticularly fatal.

Pneumococcic peritonitis is more
in females than in males. It has a
encapsulated. Pneumococcic perito
of viscera is more common when t
stomach or duodenum than in the l

tract, perhaps on account of the frequent presence of the pneumococcus in the sputum which has been swallowed.

The exudate in this form is quite characteristic, being odorless, of a yellowish green color, rather gummy in consistency, at first turbid and with a limited number of flaky coagula in it, later becoming thicker and more characteristically purulent.

The anærobic bacteria, for which much was claimed by French observers, have not been accorded much pathogenicity by more recent workers.

We must ever bear in mind that the bacteriology of peritonitis itself is often very different from the bacteriology of the process to which it owes its origin, and in this respect we are in much the same position as the clinician not so many years ago when his ideas of living pathology were being drawn from post-mortem findings.

The first means of defence of the peritoneum against infective agents within is absorption. I have pointed out that a mechanism does exist for the absorption of inert particles or bacteria, and the extraordinary rapidity with which this takes place is well shown by the experiments of Buxton and Torrey and verified by many others. They found that typhoid bacilli or particles of lampblack injected into the peritoneal cavity of a rabbit passed through the diaphragmatic lymphatics into the mediastinal lymph-nodes and thence into the thoracic duct and blood stream in five to fifteen minutes after infection. The omentum also aids materially in the process. The inert particles or bacteria are rapidly entangled upon its surface by a fine fibrinous deposit and at once taken up by phagocytic cells which, then, either digests them *in situ* or carries them into the deeper tissues.

Thus, insoluble particles are absorbed either in a free state or after they have been englobed by phagocytes. They are taken up exclusively by the lymphatics, while soluble substances pass into the blood directly as well as into the lymph vessels.

But failing absorption, the peritoneum can still wage a

valiant battle within. Injurious agents quickly set up an out-pouring of serum which contains antibacterial, antitoxic and opsonic bodies and phagocytic cells. Buxton and Torrey found that typhoid bacilli injected into the peritoneal cavity of a rabbit, provided that the dose was not too large, were rapidly destroyed. The immune substances of the serum at once poisoned the bacteria, so to speak, causing death and granular disintegration. This effect often occurred so rapidly as to receive from the experimenters the name of explosive destruction. This was not always an unmixed blessing since the rapid liberation of endotoxins was sometimes sufficient to cause fulminating toxæmia and death of the animal. If, however, this primary toxæmia was not overpowering, the impending danger of implantation of infection upon the peri-toneum was averted. These experimenters point out that the so-called shock which carries off many patients in the early hours after operation may be due to this explosive destruc-tion of disseminated bacteria and the liberation of their toxic products in overwhelming dose into the circulation. This is a strong argument against the dissemination of infective material by operative or other means, and renders the practice of flushing out the abdominal cavity of very doubtful propriety.

In addition to the serous exudate, there is very rapidly deposited upon the peritoneum, under the influence of irri-tants, a very fine and at first invisible film of fibrin. This serves to ensnare the bacteria and render them susceptible to the action of phagocytes, which takes place much more satisfactorily when the phagocytic cells are allowed to move over a surface than when they float in fluid. The cells chiefly concerned in engulfing the particles are the macrophages, or cells of the peritoneal fluid, though it is found that in order to dispose effectively of the bacteria there must be in a short time a considerable response of the microphage cells from the blood.

Even in case a portion of the peritoneum is irrecoverably damaged, Nature frequently comes to the rescue by throwing

about that area such a wall of protective exudate, at first fibrinous and later organized, that the general cavity is protected.

To what extent one can trust this spontaneous exclusion of dangerous areas has caused some of the most animated controversies in abdominal surgery, and to this point I shall return in the consideration of treatment.

Other things being equal, infections beginning from the margins of the peritoneal cavity are less dangerous than those beginning centrally, because of the greater dangers of diffusion of sepsis in the latter case. Also those which arise in the upper zone are more serious than those arising lower, on account of more rapid diffusion and greater activity of absorption in the diaphragmatic area.

The type of organism and the individual resistance are important with regard to the outcome but are fortuitous factors which can be but little influenced at the present time by the efforts of the physician. Probably we shall hereafter learn to employ specific serotherapy to second our other efforts, and already we have cases in which such treatment has seemed productive of good results.

The rapidity with which infectious material is let loose within the cavity and its amount are of great importance. This is the same as the question of dosage which is so important in experimental work. A slow escape of organisms gives time for complete absorption or for defensive adhesions. Such a condition we often find about a chronically diseased appendix, gall-bladder or Fallopian tube, or about slowly advancing ulceration of the stomach, or, less frequently, of the ileum in typhoid fever. A more rapid escape may give rise to a local peritonitis which has in its smaller sphere all the pathological features of general peritonitis, differing only in extent, the infection being overpowered before generalization. This may terminate in the production of adhesions or may leave a residual abscess such as we find in certain cases of appendicitic or subacute perforation of the stomach.

Foreign material, such as food, fecal matter, bile, pan-

creatic juice, urine or cyst contents in the various disruptive accidents within the abdominal cavity, or extraneous substances introduced into the abdomen through its external wall greatly increase the chance of the bacteria obtaining a foothold.

It is certain that any procedure which favors the spread or diffusion of infection from the point of entrance is highly inexpedient and, *per contra*, whatever hinders diffusion and assists in localization is desirable. Our aim is therefore to minimize diffusion. This is the foundation stone of rational preliminary or palliative treatment, and our postoperative methods must be consistent with it.

Intraperitoneal diffusion results from the operation of discoverable factors, many of which may be greatly influenced by appropriate measures. It is true that we are able to influence but slightly the tendency to diffusion by capillarity or by virtue of the increase of fluid and the motility of organisms, as well as the spread of infection which takes place by way of the subperitoneal lymphatics; these are constant disadvantages under which we labor but fortunately are not the chief ways by which diffusion is increased.

The experimental work of Meisel and Yates has permitted a definite formulation of some of the principles, the operation of which we recognize clinically.

Both Meisel and Yates observed increased diffusion as the result of general bodily activity and diaphragmatic movement, and they both found that the influence of posture and of gravity in draining noxious fluids to the lower and less dangerous portions of the cavity was most marked when general bodily respiratory and peristaltic movements were diminished to a considerable extent. It is obvious then that rational treatment must be directed toward the inhibition of those physical and physiological activities which aid in diffusion and toward the removal of any source of continued infection. We utilize this knowledge in a practical way when by drainage and posture we encourage the gravitation of infected peritoneal fluids to the lower and less dangerous portions of the peritoneal cavity.

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The recognition of peritonitis itself is usually not difficult. The determination of its origin often gives great difficulty. The previous history is most important, since a knowledge of the prior existence of disease of an intra-abdominal organ frequently directs our search for the source or confirms our ideas derived from the present attack and the examination. Thus, a history of antecedent gastric disturbance is of great aid in the diagnosis of perforating gastric or duodenal ulcer, and in its absence the case is almost invariably diagnosticated as perforative appendicitis. Dr. William E. Hughes succeeded in recognizing an early case of perforated duodenal ulcer, which he referred to me, by the aid of a previously undescribed sign in this condition, viz., the demonstration of the presence of both gas and fluid in the abdominal cavity by means of the metallic tinkling obtained by tapping two coins together over the air space in much the same manner as is done in pneumothorax. The patient was operated upon fourteen hours after perforation and made an uneventful recovery.

In women a history indicative of uterine or tubal infection is significant, and the importance of a history of typhoid, dysentery, or trauma is too obvious to require more than mention.

However, so great is the preponderance of cases due to disease of the appendix, the gall-bladder, the pyloric region, or the internal genitalia, that in the vast majority of instances we are able to make a diagnosis, with considerable certainty, from the consideration of a single attack together with the physical examination.

The recognition of the existence of peritonitis is, as I have said, in the majority of cases relatively easy. It is ushered in by pain, usually general, but tending at some time to point by location to the seat of the infecting process. Thus in gastric, duodenal or cholecystic disease the pain is apt to be high up in the abdomen or in the back, while in pelvic or appendiceal disease the pain is usually felt in the pelvis or lower abdomen, although with a long appendix inflamed

at the tip the pain may be greatest wherever the tip happens to lie. With fulminating peritonitis, the general involvement of the peritoneum may be established before the period of general pain subsides, thus increasing the difficulty of the diagnosis. This is quite often the case in perforations of the stomach, duodenum or gall-bladder.

Immediately following the onset of pain there is practically always nausea and usually vomiting.

Reflex rigidity of the abdominal muscles, with tenderness upon pressure, which is generally greatest over the source of the infection, are early and constant signs.

Pain, vomiting, and rigidity form the diagnostic triad. There are however other signs of considerable importance. The facies, the posture, the pulse, the increasing distention, the regurgitation and vomiting of the later stages: all the clinical manifestations have been acutely observed from the time of Hippocrates, and we can scarcely hope to add to the many lucid and vigorous pictures which have been drawn.

It is well known how greatly this picture may be distorted in the presence of typhoid fever. The benumbed sensorium and disturbed metabolism do not respond in the same way as does the healthy individual. We are usually made aware of the occurrence of some intra-abdominal catastrophe, but we must not expect typical symptoms. It is often announced by sudden, sharp abdominal pain, but often there is no more than abdominal distress, and the pain, when sharp soon moderates and may completely disappear. Thus the first member of our diagnostic triad is weakened.

Nausea and vomiting are more often absent than present. The second member of the triad forsakes us.

Rigidity is often slight or entirely masked by the presence of the tympanites. Thus our third mainstay is taken away.

Our chief reliance however must be pain or distress. Without it we shall hardly recognize a case of perforation in time to be of service. If with this we now observe a marked change in the patient's condition; a rising pulse and respiratory rate with a fluctuation of temperature up or down, with

any abdominal tenderness and change of tension of its wall, exploration should not be deferred. The leucocyte count is of little value, if any, in the initial diagnosis, and to wait for movable dulness in the flanks and obliteration of liver dulness is to lose the patient.

Mr. Moynihan, in his address on Inaugural Symptoms (*British Medical Journal*, Nov., 1908) has called attention to the fact that in the early stages of perforative peritonitis collapse and the rapid pulse are absent. He has also shown the value of noting the rigidity of the abdominal muscles and especially of the diaphragm, as shown in short, " catchy " respiratory movements.

In other forms of peritonitis the value of the leucocyte count and especially of the differential estimation has received considerable attention of late. Taken in conjunction with the clinical aspects, as indeed all laboratory results must be, they are of distinct service. I have learned that a low leucocyte count in the presence of a manifestly severe peritoneal infection is of gloomy prognosis. Such a state of affairs might occasionally induce me to defer operation until a rising count and general improvement should denote increased resistance.

Provided there is a high leucocyte count, I do not regard a high polymorphonuclear percentage with the alarm manifested by some. But if this is added to an already low count it should increase one's apprehension.

Conditions to be differentiated are intestinal obstruction, acute pancreatitis, ruptured ectopic pregnancy, pneumonia and diaphragmatic pleurisy, acute gastro-enteritis, Dietl's crises, mesenteric thrombosis and the visceral crises of tabes, purpura, and the erythema group of skin diseases so well portrayed by Osler. It is scarcely possible for me here to give a practical discussion of the differential points to be considered in distinguishing these diseases. Their symptomatology is readily accessible and the chief point is to bear them in mind. I wish to emphasize one fact which has been pointed out by Bloodgood and is I believe too little appreciated by

the profession, namely, the constancy of a leucocytosis in intestinal obstruction before the onset of peritonitis. For those who advocate delay in grave cases of appendiceal peritonitis to consider a severe case of obstruction as one of peritonitis by reason of a high leucocyte count is a fatal error; this mistake has occurred.

The treatment of diffuse peritonitis constitutes the most important problem of abdominal surgery, and the great advances which have been made in the treatment of this disease during late years have resulted from a combination of early operation and attention to details. It is hard to keep more than one aspect of a question prominently before the profession at the same time, and the active discussion and improvements of the detailed treatment which have been going on during the last three or four years have partially diverted attention from the necessity of quick action. Therefore, in connection with the uniformly good results to be obtained by means now at our disposal, when brought to bear within the first few hours, I wish also to emphasize their frequent futility in the later stages. Peritonitis early is practically a different disease from peritonitis late.

It is a mistake to begin the consideration of treatment with operation, since the pre-operative conduct of a case is so important with regard to the success of any measures taken later.

The first sign of oncoming peritonitis, or even of a condition known frequently to give rise to it, should be the signal for the institution of anatomical and physiological rest of the intra-abdominal organs, and particularly the gastro-intestinal tract. I have pointed out the importance of intra-abdominal diffusion and the factors which produce it. By rest and quiet in bed we diminish respiratory activity and the motion of the intestines consequent upon general bodily movement.

The important factor of peristalsis we seek to control by withholding all nourishment by mouth, solid or liquid. The general practice of giving a purge for abdominal pain should

be discouraged, since it favors the most potent physical factor
in the dissemination of sepsis. So many cases of gastro-
intestinal derangement respond readily to this simple treat-
ment that a false analogy has been drawn in regard to its
applicability in the early stages of appendicitis and other acute
surgical conditions within the abdomen. To purge these cases
is contrary to reason and common sense, and every surgeon
has observed that those cases that have been actively purged
are in general more severe.

The use of morphine, or opium derivatives, in the treat-
ment is to be most strongly condemned. Before operation it
deceives both physician and patient and may be the cause of
operative delay. It retards peristalsis, but the good effect in
this respect is overcome by the increase in intestinal retention,
in this manner adding another factor of toxic absorption to
that already great enough. Moreover, opium has been found
to diminish leucocytes, and thus in another way to act against
the protective forces of the body.

The postural treatment should be begun at once. Not
only are vicious fluids thus drained to the least dangerous
portion of the abdomen, but the omentum—the abdominal
scavenger and organ of phagocytosis—is aided to seek the
site of the lesion. If the patient must be transported to the
hospital, as is most often the case, he should be maintained
in a semi-sitting position in the ambulance. The posture
should be maintained if possible during the operation and
until convalescence is established. Attention has been called
to cardiac weakness as a contraindication to the position,
but personally I have not observed it.

Cold applications to the abdomen are grateful and perhaps
serve to diminish peristalsis and absorption. A useful by-
effect of this application is that it helps to keep the patient
quiet and also discourages too frequently meddling examina-
tions after the diagnosis is made.

The peritonitis patient needs water. He is bled into his
splanchnic vessels by their reactive dilatation, and fluids are
still further withdrawn by their increasing accumulation in

the lumen of the intestine and in the abdominal cavity. The general bodily tissues are dehydrated. This is the message which the body seeks to tell us by the small-volumed pulse and the pinched Hippocratic facies. Yet if we give water by mouth we excite peristalsis which, we have seen, favors diffusion of septic materials and hinders exudative exclusion of the focus of infection. On the other hand, if the infection be severe enough already to produce paresis of the bowel, the water is unable to reach the large intestine, in which the absorption of fluids takes place. In this manner so far from accomplishing our object of re-filling the depleted vessels we not only fail in this but also add to the accumulation of fluids in the bowels and increase distention. The general bodily functions are depressed by the lack of their normal fluid contents. The bone marrow, in which are elaborated many of the products antagonistic to infection, is under a disadvantage in this production. The kidneys, deprived of their normal amount of blood and working under low secretory pressure cannot eliminate the deleterious products of metabolism and infection. The heart suffers mechanically from the diminution in the volume of the circulating blood, and to this we have added the poisonous effects on all the tissues of concentration of toxins produced by bacterial growth and often by stagnation of the intestinal contents. For obvious reasons it is impracticable to supply the need for water by hypodermic or intravenous infusion. It remained for Murphy to give us a method for supplying water to the body in almost unlimited quantity. This consists in the constant administration of normal saline solution by way of the rectum. I am led to speak of this procedure at some length because I believe that it is in many cases a life-saver, and I should like to see it even more widely used and the method of administration perfected to the last detail. The normal antiperistalsis of the large bowel, demonstrated by Cannon, is assisted by the reverse mucous currents described by Bond, and the gentle onward pressure of the fluid as it enters carrying it upwards throughout the extent of the colon where fluid absorption is

most active. Even the lower portion of the ileum may in some instances receive the fluid, as it has been repeatedly demonstrated that in life the ileocæcal valve is not competent to prevent regurgitation.

I began with the drop method, interrupting the flow of fluid by a pinch-cock on the tube between the reservoir and the rectum. Some time ago I discarded this for the gravity method as described by Murphy in his article in *Surgery, Gynecology and Obstetrics,* June, 1908, since we found that in this way the patient takes more fluid with less discomfort. There is less tendency to distention. The patient can pass flatus out through the reservoir, and if he strain or if the rectum contracts spasmodically the fluid contained is forced backward into the tank, thus avoiding expulsion into the bed. We have found that the simpler the apparatus the better the results. A reservoir for the saline connected by a good-sized rubber tube with a bent douche nozzle of hard rubber or glass is all that is required. The bend in the tube is for the purpose of preventing the end from being forced up into the rectum or back against its wall when the patient is in the sitting posture, since it is of the greatest importance to avoid irritation of the rectum.

Two hot-water bags about the tube, replenished at intervals and placed near the rectal end of the tube and surrounded by blankets, suffice to maintain the fluid at a proper temperature.

The level of the *top of the fluid* is a matter to be determined by experiment in the individual case. Usually an elevation of six to twelve inches above that of the rectum is best. Increasing distention and rapid flow of the saline are indications to reduce the height, while cessation of flow should induce an increase of elevation. The pressure of the fluid must be slightly greater than the intra-abdominal pressure.

The whole matter is easy if attention to detail be given, and uniformly good results will be obtained. It is often well to give a cleansing enema before beginning the continuous proctoclysis, and daily during its administration. If absorp-

tion be slow or fecal matter be expelled back through the tube, an enema will often promote comfort and enable absorption to be resumed with renewed vigor.

Under this treatment the whole appearance and condition of a patient is rapidly changed. The face loses its pallor and pinched appearance, and as the blood pressure mounts the pulse fills out and the general condition of the patient soon improves; so that I have come to regard the classical small wiry character as a quite inconstant accompaniment of peritonitis. Drainage from the abdomen, where drainage tube or gauze has been inserted, becomes more profuse and watery, the bodily functions proceed under more favorable conditions, elimination is increased, and the patient often rapidly passes out of danger. The method is applicable both before and after operation, though its greatest usefulness is as a post-operative adjunct.

In our enthusiasm for new methods we should not over-run contraindications. In this instance there seem to be re-markably few. I have seen a few cases in which I thought abdominal distention and discomfort were increased. Proper methods of administration will almost always obviate this, but it has occasionally seemed of advantage to stop the saline flow at longer or shorter intervals.

I have several times seen puffiness of the eyes and slight œdema of the legs with the passage of very large amounts of urine; and have questioned whether the patient was not receiving too much fluid. I would regard such an occurrence as an indication to slacken the administration. This leads to a consideration of whether salt in such large quantities may have any deleterious effect upon the kidneys or the organism as a whole. Certainly the thorough flushing with large amounts of fluid more than counteract any ill effects, but I would advise cutting down the salt content to as small a percentage as is consistent with a bland non-irritating quality of the fluid. Very material increase in the quantity of urine passed is an indication that the saline is being well absorbed.

Finally, I may say that I have tried a number of contrivances for automatically delivering into the rectum saline at a constant temperature, but have not yet been convinced of their superiority or even of their equal merit with the simple method I have indicated when controlled by a nurse of experience. Small quantities of predigested beef solution or sometimes whiskey are advantageously added to the saline for nourishment or stimulation.

Though we hail with delight such useful adjuncts in treatment, after all, the most important single factor in the successful treatment of peritonitis, however caused, is early operation.

The Murphy method of administering saline or any other method of treatment naturally is valuable primarily as an adjunct to operative interference. No one can question the propriety of operation. We must determine, however, the best time for operation in each individual case, and the method of procedure after we do determine to enter the abdomen.

The great factor in success in dealing with diffuse or generalizing peritonitis is that of time. Early operation means success, late operation probably failure. If we are able to relieve the intra-abdominal tension, remove the toxic material and close the avenue of infection within 48 to 50 hours, our chance of success, using all the modern methods of after-treatment, is as 30 to 1.

After fifty hours the mortality gradually increases until it reaches, with a few days delay, a point at which a large percentage of cases become of necessity fatal.

Last year Murphy reported a series of 51 cases of diffuse peritonitis of varying etiology with but two deaths. All these cases were operated on within forty hours from onset. Murphy does not give his experience with cases of spreading or generalized peritonitis operated on at a later period, but who can doubt that the mortality would mount rapidly beyond that extremely low figure for early cases.

To these statistics I can add those of 118 cases of my own, of diffuse peritonitis all of appendiceal origin, with the

exception of seven cases due to perforation of stomach and duodenum.

DIFFUSE PERITONITIS OF APPENDICEAL ORIGIN.

Duration.	Cases	Recovered	Died	Mortality per cent.
Under 40 hrs. 63	62	1	1.5 per cent.

Only those cases were chosen which exhibited at the time of operation macroscopic evidence of wide peritonitis with free purulent exudate and no limiting adhesions. In addition to the macroscopic evidence of diffuse peritonitis I have required that a culture taken from the exudate at a distance from the appendix, the focus of infection, should yield pathogenic organisms. This latter requirement, on account of the absence of a culture, has ruled out a number of cases which should from their pathology be included in the tabulation. It has seemed best to do so, however, in order to avoid a possible objection that cases showing only a sterile exudation had been included. Many cases of acute appendicitis operated within 24 hours of the onset of the attack show free fluid in the peritoneum at the site of operation, and in the pelvis, which to the naked eye looks purulent, but culture of the same is negative; all such cases, of which we have a number, have not been included in this compilation. Many of these I close without drainage. The great difficulty in distinguishing by inspection a septic exudate from a sterile reactive fluid which is innocuous or even defensive is well known.

As nearly as possible we have tried to estimate duration from the beginning of severe symptoms denoting involvement of the peritoneum. We do not hold that our diagnostic acumen is sufficient to compass this desirable end with mathematical accuracy; still we feel sure of a reasonable approximation.

Deaths from septic pneumonia, cardiac exhaustion, septic endocarditis, pulmonary embolism, secondary obstruction, subdiaphragmatic and pulmonary abscesses have been included

without comment though peritonitis was not present at autopsy, since we think it proper to reckon the mortality from the standpoint of the whole disease rather than to try to eliminate those cases in which the peritoneum recovered itself.

In the last 55 cases of general peritonitis in which I have used continuous saline treatment, there have been 12 deaths, all of which were in cases of over fifty hours duration.

In the last group are included all cases of general peritonitis of appendiceal origin in which any operative intervention was attempted. In a number of this group of cases practically moribund at time of operation, nothing more than a suprapubic puncture and tube drainage under nitrous oxide anæsthesia were done.

It is readily seen that the total mortality of such a collection of cases means practically nothing. We attempt nothing more than to show the prognosis of diffuse peritonitis at different periods as treated by operative and rational postoperative methods. Every series of statistics compiled in a way to show the influence of early operation in reducing the mortality shows the same striking result and they could be quoted in great number. In perforated gastric and duodenal ulcer Brunner and Tinker found the result almost invariably bad after the eleventh hour. Miles, in 46 cases found the operative mortality within the first 12 hours only 26.3 per cent.; in the next 12 hours, 44.4 per cent., in the third 12 hours, 50 per cent., and after that 91.7 per cent. Our own experience at the German Hospital in this class of cases, which, true, have been comparatively few, has been most unusual, no deaths.

So far as appendiceal peritonitis is concerned it is evident that if treated by operation within the first forty hours after perforation, or even within the first fifty hours, it has become in experienced hands a condition associated with a comparatively low mortality.

The alarming rise in mortality which ensues after passage of the fifty-hour line casts a perilous responsibility upon the man who wishes to keep a case long under observation or to try palliative measures first.

It may be objected that many cases which show early free peritonitis will, under proper treatment, localize the infection and become more favorable surgical risks. I have too great respect for the defensive powers of the body as a whole, and the peritoneum in particular, to deny that this is possible. And I doubt very much whether the mortality of late operation will be less, even in the fortunate event of localized abscess formation, than we now have in early operations. Moreover, I do not by any means grant that all cases will proceed so fortunately. Certainly some cases will fail to exclude the infective focus and go on to general peritonitis and death. It is interesting to note in this connection that I had in this series 92 cases under fifty hours with a mortality of 3.2 per cent.

The foregoing remarks concerning immediate operation refer to cases within the first forty to fifty hours after the onset of the diffuse peritoneal involvement. Every case seen during that time should be operated upon, barring unusual and extraordinary complications or features.

When we come to consider cases of peritonitis after the first fifty hours following the onset of the peritonitis a more serious problem confronts us,—as has already been stated cases of diffuse peritonitis are most liable to succumb within two or three days or else they live almost a week. The question therefore arises, shall we treat the cases after forty or fifty hours as we do those before?—that is to say, by immediate operation, or are some of them to be treated expectantly in the hope that they will either recover or that intervention at a later period will give us better results?

I believe it to be impossible, at least it is for me, to always differentiate between a diffused and a diffusing peritonitis, or a localized peritonitis with diffusing peritoneal irritation, or between a diffuse and general peritonitis. The physical signs may seem to indicate that the whole peritoneum is involved in the inflammatory process, yet upon operation we discover that the infection is localized and that there is a widespread accompanying irritation. On the other hand, all

of us have seen cases in which there was apparently only a local process, whereas operation or autopsy disclosed a peritonitis practically invading every nook and corner of the abdominal cavity. I do not mean to say, however, that the differential diagnosis between the conditions mentioned cannot be made in many of the cases which come to our notice. Upon careful study and examination we can, as a rule, formulate in a fairly clear manner a correct opinion as to the intra-abdominal lesions present. In the exceptions, however, *i.e.*, those in which we cannot make such a definite diagnosis, the difficulties in the way of determining the proper course of procedure are vastly increased. In the class of cases under discussion, having made up our mind to operation, when the patient is relaxing under the anæsthetic palpation may reveal a different condition than before anæsthesia and thus lead to a different conclusion. Palpation must be made very gently, as I have known an abscess to be ruptured by the surgeon being too strenuous in his efforts to form a positive conclusion. The area of abdominal muscles immediately overlying the lesion is the last to relax.

Broadly speaking, the cases of true diffuse peritonitis more than fifty hours old, which come to our notice may be divided into two classes.

In the first class we may include those cases in which the patient shows a good resistance to the disease. The temperature will be elevated, but not excessively so, the pulse rapid but of fair volume and tension. In all forms of peritonitis rigidity is one of the earliest signs. In appendiceal peritonitis it is usually associated with distention unless the spasticity of the muscles at first is so great as to preclude this. In peritoneal irritation or inflammation of the upper abdomen such as that caused by the perforation of a gastric or duodenal ulcer, the rigidity is one of the earliest signs and abdominal distention does not come on until several hours later. In the type of disease under discussion we note, however, the absence of cyanosis and of a leaky skin—indications that the infection is getting the upper hand. The leucocyte

count is fairly high and the polynuclears present in high percentage. In other words, we have every evidence that the patient has not been overwhelmed by the initial toxæmia, but on the contrary that the body resistance fairly equalizes the infection.

In such cases as these the surgeon is safe in delaying operation until all the evidences of an acute inflammatory process have subsided, that is to say, until the peritonitis has become subacute, stationary and without active symptoms. If the patient has been progressively improving further delay under such conditions will make his recovery more certain. As a general working rule we can say that delay is far more liable to do good than harm, and that in case of doubt we should always be more prone to hesitate than to operate.

The second class of cases is that which includes those patients who have apparently been making a losing fight against the disease. The clinical picture is characteristic. The anxious facial expression, the cyanosis with small rapid, running pulse, the leaky skin, and the enormous abdominal distention gives us evidence in abundance that the prognosis is a bad one. If in addition to the symptoms mentioned we have a low leucocyte count with a high percentage of polynuclears we have still further proof, if it were needed, that the defences of the body against the bacterial poisons have been almost completely overcome. It is my opinion that such cases should not be operated upon.

When such a patient is seen we should proceed at once to institute the proper medical treatment, namely: This consists of (1) absolutely nothing by mouth, (2) ice to the abdomen, (3) continuous proctoclysis by the method of Murphy (4) avoidance of morphia, except for the plainest indications of mental distress or uncontrollable restlessness (5) the semi-erect position (6) lavage of the stomach.

My aversion to morphia is not based on any theoretical pros and cons. I cannot say therefore whether the depression of such peristalsis as still exists with consequent liability to meteorism, the inhibition of leucocytosis or the lowering of

general metabolic activity and functions are the unfavorable results of a routine morphia treatment, but merely that it has seemed to me to work adversely in these cases:

I am accustomed to add about 100 c.c. of predigested beef to the litre of saline by way of alimentation about every four to six hours.

It is impossible to formulate definite rules for the treatment of peritoneal inflammation. A consideration of the treatment of diffuse peritonitis involves also that of the conditions which precede it or resemble it. The most prevalent cause of peritonitis, such as we have under discussion, is appendicitis, and we may use the peritoneal sequelæ of an acute appendicitis as typical cases.

It will be agreed that all cases of appendicitis with the inflammation confined to the appendix should be operated immediately.

When the disease has progressed beyond the appendix we may have one of several conditions:

(1) A strictly localized abscess without signs of diffusion and without peritoneal irritation is a condition for immediate operation.

(2) A localizing abscess with diffuse peritoneal irritation is as a rule more safely treated by waiting until the active peritoneal inflammatory symptoms have subsided. It must be remembered, however, that there may be leakage from a weak abscess wall and that this can give rise to a severe form of diffuse peritonitis, therefore a percentage of this type of cases should be operated in the presence of peritoneal symptoms.

(3) A circumscribed peritonitis with a diffuse peritoneal irritation. In these cases, we often have practically the same symptom complex that is shown in an established diffuse peritonitis. When such a process is at its height it is often impossible to say whether we have really a diffuse or a circumscribed peritonitis.

My practice in these cases, when ill more than forty to fifty hours, as to operation depends upon the presence or absence of some definite localizing sign of the original seat

of the peritonitis. When the patient's abdomen is uniformly rigid or uniformly distended and I cannot detect any point of excruciating tenderness in the right iliac fossa, flank or loin, and the appendix cannot be located in the pelvis by rectal or vaginal examination, I do not operate, I treat such cases by the Ochsner method supplemented by proctoclysis as practised by Murphy.

As soon as a well-localized area of rigidity and tenderness is well marked and the evidence of peritoneal irritation is practically subsided, operation offers a much greater percentage of recoveries than in the stage immediately preceding this condition.

The situation of the localized focus is of importance. We may have it toward the flank, loin, or pelvis, and then localization and disappearance of peritoneal irritation will be much more rapid and complete than when it is toward the median line. In fact, in the latter instances delay is absolutely essential.

In peritonitis of the upper abdomen our course of procedure must be somewhat different, depending upon the source of the lesion. To make myself thoroughly understood I will individualize.

Peritonitis due to gastric, duodenal, intestinal perforation, rupture of the gall-bladder, liver or spleen must be operated as soon as the patient is seen if any chance of recovery is to be offered.

Acute peritonitis due to pancreatitis should not in my judgment be subjected to immediate operation if the best results are to be obtained, nor peritonitis the result of gall-bladder inflammations excluding rupture of the healthy organ, gangrene and ulcerative perforation.

Peritonitis of the lower abdomen, other than that due to appendicitis and acute pyosalpinx, should be operated at the earliest possible moment to obtain the best results. In cases of less than forty-eight hours duration we operate immediately.

Operation.—Very much depends on the anæsthesia, which must be carefully administered. There must be no struggling

to increase operative difficulty, retard the speed of the operator or to spread sepsis.

The surgeon may overcome in a measure the increased operative difficulty by a proper incision. The best incision is one which affords immediate exposure of the area to be attacked and is large enough. Better too large than too small. An incision through the semilunar line is usually better than a muscle splitting incision, as it is possible thereby to avoid the vice-like grasp of the spastic recti or flat muscles. The pathology must be quickly recognized and proper action determined without unnecessary exploration and evisceration. If, on opening the peritoneum, pus gushes out, I make it a practice to insert a glass tube in the pelvis and thus remove much of the fluid before inserting the gauze packs. I believe that this procedure minimizes the chances of spreading the infection.

I have found that the introduction of gauze packs at this stage to wall off the general cavity from the site of operation, introducing them to just beyond the site of the lesion, is of great assistance. It precludes the escape of the distended loops of gut upon the soiled field of operation. As a rule the pus immediately surrounding the source of infection is more foul and dangerous than that at a distance. By the proper arrangement of gauze the chances of diffusion of this foul pus are at least minimized. Every step under control of the eye can be more swiftly and accurately performed with less danger of engrafting a mixed infection upon that already existing. The slight trauma to the peritoneum attendant upon the careful placing of these pads is, I believe, a negligable factor when contrasted with the advantage derived. The condemnation expressed by some operators in regard to this procedure is readily convicted of being nothing more than opinion unsupported by fact. The uniform recovery of cases treated in this manner when under the time limits I have pointed out is sufficient rebuttal.

The objects of surgical intervention may be considered under three main headings, viz.: (1) The primary lesion.

(2) The products of inflammation or leakage. (3) Intestinal paresis.

1. First the exciting cause of the condition must be sought out and remedied. Simple laparotomy and drainage will very rarely materially influence the result. In desperate cases not permitting formal procedures I have frequently attempted a palliative puncture and drainage but, with rare exceptions, have never observed any good effect. Indeed, the evacuation of large amounts of pus and relief of tension have often had a diametrically opposite effect. In cases where the operation was really nothing more than a paracentesis under momentary gas anæsthesia I have seen the temperature begin to mount at once and in the course of a few hours the patient would succumb. This effect is so different from that usually ascribed to relief of tension that I confess some doubt in regard to the cause. It would appear that absorption is in some way hastened, whether through the small avenue of the fresh puncture, which I think highly unlikely, or through reactively dilated vessels of the peritoneum I am unable to say.

In general those organs which admit of ready removal, viz., the appendix, the gall-bladder, the Fallopian tubes, Meckel's diverticulum and infected cysts, when they are the starting point of the process, should be removed entire. Perforations of the bowel can usually be repaired in such a way as to preserve its continuity.

In a word, the primary focus must be so treated as to insure a discontinuance of its furnishing septic products to the peritoneal cavity, which may be done by complete removal, by repair or by excluding it from the general cavity.

2. Concerning the disposal of the products of inflammation or leakage there is no general agreement, and we find men of great experience and excellent judgment advocating the most widely different methods of procedure and quoting statistics which vary greatly in support of their views. Free general irrigation, local irrigation, wet sponging, dry sponging and no irrigation all have their strong adherents.

Concerning the use of antiseptic solutions for irrigation,

both clinical and experimental work prove that they do more harm than good, and they have rightly been generally abandoned. Those who irrigate almost universally recommend normal salt solution, relying entirely on its mechanical cleansing effect.

Though my results have been incomparably better since I abandoned the irrigation treatment about five years ago, my methods have perhaps changed so much in other respects as to render the figures valueless from a controversial standpoint.

There are certain extensive collections of cases which seem strongly to support the view that irrigation is harmful rather than beneficial.

Murphy quotes Harte and Ashhurst's tabulation of 200 cases of typhoid peritonitis, as follows:·

HARTE AND ASHHURST'S TABULATION.

	Cases	Recovered	Died	Mortality
Drainage, not wiping or irrigating	17	10	7	41 per cent.
Wiping and draining 31		12	19	61 per cent.
Irrigation and drainage 176		46	130	74 per cent.
Wiping, irrigation and drainage 11		1	10	90 per cent.

He points out that it is remarkable to note how each additional procedure adds from 15 to 20 per cent. to the mortality.

One year ago Nitch reported the following collection of cases of diffuse appendiceal peritonitis bearing on this point.

GENERAL IRRIGATION.

	Cases	Deaths	Mortality
St. Thomas Hospital staff	100	80	80.
Sargent	19	18	94.7

DRY SPONGING OR LOCAL IRRIGATION.

	Cases	Deaths	Mortality
Morton	14	2	14.2
Sargent	6	0	00.
Burger	33	1	3.03
Nitch	30	3	10.

It is certain that in general the tendency is towards less irrigation and less sponging and on the part of those who use irrigation to restrict its use to more and more narrow

limits. My objections to general irrigation may be summed up as follows:

1. It consumes time which we cannot afford to lose.

2. It certainly diffuses infectious material and the products of infection.

3. By causing us to manipulate the bowel it has a tendency to cause postoperative paresis.

4. When we use efficient drainage and methods of administering saline, irrigation is unnecessary because under these conditions the peritoneum is amply able to take care of any fluid present. When we have a peritonitis in which pus flows immediately upon opening the peritoneal cavity and is seen to come from every point within apparently, as far as one can see through the ordinary abdominal incision, it is not by any means certain that we are dealing with a general peritonitis. So that to speak of washing out a case of diffused peritonitis perhaps sounds all right, and may be theoretically all right, but practically is all wrong. A diffused peritonitis may not by any means be a general peritonitis, therefore to wash such a case means to make it general, if it is not one already. For some years I have entirely given it up and employ sponging in only those cases which show a local highly foul and purulent exudate or extravasated gastric or intestinal contents. I am convinced that it is a mistake to use it in all cases in which the peritonitis is not demonstrably generalized and complete, and under the exigencies of operation it is very rarely possible to be certain without doing more harm to those which are found not to be complete than we benefit this latter class of cases by irrigation—if indeed irrigation benefits them at all.

I have found it to be a mistake to wipe away the coating of protective lymph from the bowel. I am sure that we run a similar risk of washing out protective collections or seropurulent exudate from certain regions of the abdomen and especially the highly important diaphragmatic area, thus exposing them to infection and the body to fulminating toxæmia from rapid absorption.

As for my own method, I sop away gently whatever fluid wells up into the field of operation, and at once or after the completion of the other intra-abdominal steps of the operation I insert a perforated glass tube into the pelvis and pump out whatever fluid is found there. I do not go on any extensive tour of the abdomen hunting for exudate to aspirate or wipe away. It has been seen that much of the exudate is harmless or defensive. In many very early cases I do not drain at all,—the peritoneum will do its best work when not embarrassed. These are, however, only the cases in which the exudate is not as yet frankly purulent or in excessive quantity. Scattering infection in these fresh areas and the trauma of sponging cannot well be innocuous. I leave the glass tube in the pelvis and remove it as soon as the discharge, which is systematically aspirated, becomes clear and scanty. This takes place usually in one to three days. I do not believe it is possible by this or any other method to drain the abdominal cavity completely or to relieve tension from all its parts. Therefore, when its function, which rapidly becomes entirely local, is done, it should be removed without delay. I leave the wound open, its edges partially approximated by retaining sutures of silkworm gut. If there is dangerous necrotic tissue in the abdomen which can neither recover itself, nor yet be removed, I establish a tract down to it by means of gauze tamponade. Gauze will not drain fluids properly and has a tendency to act more as a hindrance than as an aid to their discharge. That gauze is useless for drainage after a few hours is my firm conviction and I would like to see the use of the word drainage discontinued in connection with it. When used as drainage it not only fails to drain but is a barrier to drainage and may excite dangerous adhesions between coils of bowel.

In regard to the direct operative treatment of intestinal paresis in connection with peritonitis, with its accumulations, I shall only say that I am not an enthusiast.

In all procedures the least and the most rapid work consistent with attainment of the cardinal objects is life saving.

Postoperative treatment consists mainly in "letting the patient get well." He is put to bed and kept warm. At first the head of the bed is elevated. Then when he is sufficiently recovered from ether he is placed back in the semi-erect position, which is maintained by means of pillows beneath the back and of a sling beneath the buttocks. Continuous proctoclysis is given in the manner described. Absolutely nothing is allowed by mouth so long as there is risk of increasing peritoneal irritation by exciting peristalsis; this means on an average between two, three and four days. Ice to the abdomen will help to relieve the patient's pain. For vomiting I have one remedy, the stomach tube. For distention I employ stimulant enemata, at times turpentine stupes to the abdomen, the stomach pump when the stomach is distended—as frequently happens—and eserin, hypodermically. This line of treatment will only be of use, however, when we have a simple distention. Distention due to postoperative ileus must be distinguished therefrom, and requires other measures. For cardiac weakness I usually give strychnia and digitalis. Saline hypodermoclysis is the best means to promote good action of the kidneys, but caffeine given hypodermically in the form of the alkaloid dissolved in water by the aid of sodium salicylate is at times of value. I do not persist in carrying out the exaggerated Fowler position for the length of time I did formerly. I am of the opinion that intestinal obstruction, particularly in the pelvic basin, is more likely to occur if patients are kept too long in this position; therefore, I think that the object of the position has been obtained after the first 48 to 72 hours.

For other special indications I sometimes use other measures, but simplicity is the note.

The essential treatment of peritonitis I would sum up as follows: (1) Early operation; (2) Light anæsthesia; (3) Rapidity of operation; (4) Appropriate treatment of focus of infection; (5) Avoidance of flushing and evisceration; (6) Proper drainage; (7) Simple postoperative treatment by posture and proctoclysis with predigested beef for the purpose of nutrition.

APPENDICOSTOMY IN CONDITIONS OF ACUTE PERITONITIS.

BY ERNEST W. HEY GROVES, M.S., F.R.C.S.,

OF BRISTOL, ENGLAND.

Assistant Surgeon to the Bristol General Hospital; Surgeon to the Cossham Memorial Hospital.

SINCE the introduction of the operation of appendicostomy by Weir in 1902 it has been employed more and more frequently in cases of chronic disorder of the colon, and Keetley [1] has lately brought forward thirty-five cases, most of which illustrate its value in this connection. But the method also is an exceedingly useful one in conditions of acute peritonitis, especially when this has been caused by appendicitis, and in children. In some of Keetley's cases (XXII–XXV) the appendix was used " for nutritional purposes " in conditions of suppurative peritonitis. But in all these death occurred, and it is evident from the author's remarks that under these circumstances the method has not left a favorable impression. But I think that the main value of appendicostomy in acute peritonitis is rather as a means of combating shock and toxæmia than for " nutritional purposes." I suppose all surgeons are agreed in regarding the infusion of saline fluid into the tissues of the patient as the most potent means of recovery after the abdomen has been opened for acute and diffuse septic conditions. This may be done either by the veins, the cellular tissue, or the bowel. The disadvantages of direct infusion into the veins are the necessity for a separate operation and the difficulty of continuing the transfusion by this method for many hours. If the subcutaneous method be used, there is great difficulty in keeping a child still enough for its employment, and further, when a profound condition of shock and toxæmia exist concurrently, the blood-pressure is

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[1] Keetley: Proceedings of the Royal Society of Medicine, December, 1908.

so low that the fluid finds its way into the circulation very slowly. Therefore, Murphy's suggestion of employing the bowel as the channel for infusion has been almost universally adopted. It has the great advantage of allowing the reception of fluid to continue for many hours and, further, the fluid in the course of its absorption must quicken the lymph-stream in the very area affected by the septic invasion. Thus it acts locally in flushing the abdominal tissues as well as constitutionally in combating shock and toxæmia. But here again there are very real difficulties, especially in dealing with children and those who are desperately ill. Such patients do not always tolerate the tube in the rectum well. They cry and strain, and either the tube comes out or else the fluid injected is returned into the bed. And in the case of a patient who is hovering on the brink of death the manipulations necessary to keep a watch on the rectal tube tend to their harm, inasmuch as they necessitate some movement and uncovering. For all these reasons appendicostomy offers a most ready and efficient substitute for rectal infusion, for it forms a part of the operation for opening the focus of disease which actually shortens this procedure. It can then be used either continuously or intermittently for the transfusion of fluid without in any way disturbing the patient, and, last but not least, it can be varied so as to adapt it to the washing out of the whole bowel and so getting rid of the stagnating contents of the large intestine.

Most of these points are so well illustrated by the following four cases that I relate them in the order of occurrence.

CASE I.—George D., aged 8, admitted to the Cossham Hospital, October 24, 1908, with abdominal pain. Two days ago he was suddenly seized with pain in the abdomen, accompanied by vomiting. His condition grew rapidly worse since the onset of symptoms. He lay on his right side with his knees drawn up, his face flushed, and vomited frequently. Temperature 101°, pulse 124, respiration 40. The abdomen was rigid all over, tender, and with no respiratory movement. No localizing signs could be felt through the parietes but definite thickening on the right side of the pelvis was palpable through the rectum. Diag-

nosis of general peritonitis caused by appendicitis was made and the abdomen opened at once through the right linea semilunaris. A few ounces of offensive thin pus escaped and the appendix was found to be gangrenous in its distal half. There were no limiting adhesions observed. Appendix was removed flush with the cæcum and into the appendiculocæcal orifice a small Paul's tube about one-third inch in diameter was tied. The wound was packed and brought together with two silkworm gut stitches. One pint of hot water with one-half ounce of brandy was poured in through the cæcal opening; the boy's condition became notably better than before the operation.

October 25, the general and local conditions were much improved. The temperature remained at 98.2° to 98.4° and the pulse 84 to 106 throughout the day. He had nothing given by mouth, and one-half pint of water with one-half pint of peptonized milk were given per cæcum every six hours. At 6 P.M. the temperature rose to 101°, but the pulse remained at 84 and his general condition seemed good. The wound was foul, dry, and sloughy.

October 26, at 5 A.M., the boy seemed to have some sudden seizure, crying out and jumping out of bed. From that time onwards he was only semi-conscious. The pulse rose to 120 and was very small and irregular. The temperature fell to 97°, the extremities were cold, and the face cyanosed. He died at 1 P.M.

In this case it was evident that a good recovery was being made from the grave condition of septic infection, when pulmonary thrombosis or embolism probably occurred. The method of appendicostomy was, however, a faulty one as it did away with the natural sphincter which exists at the base of the appendix and which in most cases is quite competent to prevent regurgitation.

CASE II.—Alfred H., aged 6 years, admitted to the Cossham Hospital December 28, 1908, with abdominal pain. He is a thin delicate child who had diphtheria one year ago and has had a chronic cough for the last few months. One week ago he complained of abdominal pain, which was accompanied by vomiting. Both these symptoms have increased since and the bowels have not acted for three days. He lies on his back with both knees

drawn up, the breathing is rapid and shallow. Pulse 144, respiration 40, temperature 98.2°. The abdomen is hard, tender, and rigid, with dulness all over the lower part. Diagnosis: diffuse peritonitis probably arising from the appendix.

Operation.—Incision made first into the *left* semilunar line, where a quantity of thin pus was discovered and a drainage tube sewn in; then into the right semilunar line through which the appendix was found. It had completely sloughed in its distal part. There was a good deal of pus free in the peritoneal cavity, which had the usual *B. coli* odor. The stump of the appendix was tied to a rubber catheter and fixed into the upper angle of the wound. The rest of the wound was packed and drained. The patient was pulseless at the end of the operation. One pint of saline was given through the appendix every two hours and half an ounce of brandy every four hours throughout the next twenty-four hours. His general condition very slowly improved. The bowels were opened twice daily, after washing through from the appendix. The tube was removed from the appendix on December 31. By January 2 his general condition had greatly improved, but the wounds looked very unhealthy, both being covered with black sloughs. From January 5–9 he had some pyrexia (102°), pain in the hypogastrium, and painful micturition. A median collection of pus was opened through a suprapubic wound and after this he made rapid progress to recovery. The appendix stump was cauterized on February 19 and healed readily. The boy was discharged on March 11. He was readmitted on March 14 for a fecal fistula over the site of the appendix stump. This was again cauterized and he has since been quite well.

In this and the two subsequent cases I adopted the plan of opening the abdomen first on the *left* side, although the case was probably one of appendicitis. The advantage of this is that if pus is not discovered the small wound can be sewn up without fear of septic contamination, whereas if such an opening is made after a foul appendix has been explored it is very difficult to avoid introducing septic material, if such is not already present. As a matter of fact in each of these three cases pus was found on both sides of the abdomen.

CASE III.—Queenie S., aged 10. No previous illness. Admitted to the Cossham Hospital February 20, 1909, with severe abdominal pain. The pain had begun suddenly when at school two days previously (February 18), and on returning home a dose of castor oil was administered, which made the pain much worse in spite of the opening of the bowels. Vomiting occurred several times in these two days and three times on the day of admission.

Condition at 6 P.M.—Child was acutely ill with drawn and anxious expression and thoracic breathing. The temperature was 100° F., pulse 112, respiration 24. The abdomen was acutely tender, resonant, and distended, without any localizing signs. *Per rectum,* an indefinite bulging could be felt, which was very tender. The diagnosis was general peritonitis probably arising from the appendix.

Operation, 9.20 P.M.—A first incision was made into the lower part of the left linea semilunaris and a quantity of thin pus escaped. A drainage tube with a gauze wick was inserted and the rest of the wound closed. The right semilunar line was then incised and the appendix region explored. The appendix was bound down to the brim of the pelvis and sharply kinked upon itself; its distal half was merely a gray slough. A small quantity of inodorous pus was free among the coils of intestine, and there appeared to be no limiting adhesions. The appendix was sewn into the wound by two stitches and cut off so as to leave about one-fourth inch stump. A rubber tube and gauze wick were left in the lower part. As the child's condition was very bad a pint of hot saline with an ounce of brandy were administered per appendix through a rubber catheter before she left the table. This greatly improved her condition.

February 21: Throughout the night half a pint of saline was administered per appendix every three hours. All was retained. In the morning the large intestine was washed out with two pints of soap and water, a large tube being temporarily placed in the anus. The after-progress was one which gave much anxiety for several weeks. Occasional vomiting, attacks of abdominal pain, and rises of temperature to 102° or 103° F., indicated that the peritonitis had not altogether abated and on two occasions I had to open up pockets of pus which had formed between the coils of intestine adjacent to the right wound. The

appendicostomy was used for irrigation of the bowel whenever constipation and distention occurred, and this was invariably followed by much relief. By March 20 the patient was convalescent and the mucous membrane of the appendix was touched with the actual cautery. She was discharged healed on March 29.

This case illustrates very well the value of appendicostomy as a method of relieving intestinal distention as well as of introducing fluids. In it, as is so common in diffuse peritonitis, the colon was tensely distended and almost paralyzed. And though in such a condition it may be possible to introduce fluids into the bowel by the rectum it is often impossible to empty the colic contents by the latter route; whereas by the appendix stoma hot soapy water or turpentine can be introduced under such pressure that the whole contents of the large bowel are washed out, and this is greatly facilitated by the introduction of a large tube through the anus which provides for a ready escape of the fluid.

CASE IV.—Minnie D., aged 23, admitted to the General Hospital March 5, 1909, with abdominal pain. She is said to have suffered from " indigestion " for the past two years. On March 3, two days before admission, she was suddenly seized with severe abdominal pain when she was walking to work after breakfast. She returned to bed and took only fluids, but had no vomiting. The pain had greatly increased the following morning and she vomited several times. She was sent to the hospital as a case of perforated gastric ulcer. The patient was well nourished and had a remarkably placid appearance. The tongue was furred, pulse 132, respiration 24, temperature 100.6°. The whole abdomen was very rigid, but not specially tender. The rigidity was greater below than above the umbilicus. The liver dulness was unaltered and there was no dulness in the flanks. Diagnosis: acute appendicitis and peritonitis. The patient and her friends were averse to any operation as she felt fairly comfortable. During the night her condition became much worse, the pulse rising to 140 and becoming very weak.

Operation at 8.10 A.M. on March 6. An incision first made in the left linea semilunaris gave exit to a quantity of pus, and

was drained. The right semilunar line was then opened and the appendix found to be gangrenous with a concretion near its tip. No adhesions were found and there was a large quantity of sero-purulent fluid, which welled up from Douglas's pouch. The stump of the appendix was fixed in the wound and the rest cut off. A large tube was passed through the posterior vaginal fornix into Douglas's pouch, and another into the right iliac wound. The operation was concluded at 8.40, by infusing one ounce of brandy and one pint of hot saline into the colon through the appendix opening. The saline was repeated through the same channel every two hours and the patient seemed to rally well from the operation, but later on she rapidly sank and died at 5 P.M.

This short series of four cases represents the most desperate type of illness arising from appendix peritonitis, and the fact that in two out of the four recovery was attained shows a good result of the treatment. A third case would probably have recovered if it had not been for the pulmonary embolism.

One or two further points remain for discussion. The first relates to a comparison between this method and the ordinary one of complete removal of the appendix when accompanied by diffuse suppuration, regarded merely from the point of view of rapidity and simplicity of technical procedure. I feel quite sure that appendicostomy is the simpler method of the two. Fixing the appendix in the wound and cutting it off is simpler than closing the cæcal orifice of the appendix after it has been removed.

Then as to the actual method of performing the appendicostomy, the simpler the details the better. It is generally impossible to preserve the mesentery of the appendix in acute inflammatory conditions, and I have not attempted to do so. The appendix is freed right down to its cæcal junction, and, after fixation by two stitches which pass through its outer coats in the groove between it and the cæcum and through the parietal peritoneum and muscles, it is cut off about one-quarter inch from the cæcum. Two stitches are then passed from its lumen at opposite points and fix it to the skin. These stitches

are left long and serve readily to find and fix the stoma for the introduction of the irrigating catheter at any future time. In the first two cases I tied a tube into the appendix stump; but in the last two the stoma was arranged as I have described, and this was found perfectly satisfactory, and it is very remarkable how efficient the sphincter at the base of the appendix proves itself to be, as there is little or no escape of gas or fæces through it after the tube is withdrawn.

When the function of the stoma is at an end it is very readily closed by the application of the thermocautery to its mucous surface.

I would summarize the conclusions to be drawn from the above considerations as follows:

1. The value of appendicostomy in acute diffuse peritonitis is very great in these respects: (*a*) It serves to introduce saline fluid at will in almost any quantity after the operation. (*b*) This introduction is more likely to be efficient than if given by the rectum, especially in children. (*c*) It is less disagreeable to the patient and involves less exposure and moving than does rectal infusion. (*d*) It serves as a ready means of washing out the large intestine and so relieving pain, distention, and the retention of toxic intestinal contents.

2. It is rather a quicker and simpler operation than removal of the appendix.

3. The smallest possible piece of the appendix should be retained, enough to preserve the sphincter at its base, and no more.

4. It is better not to tie in a tube but to reinsert this whenever necessary.

THE APPENDIX VERMIFORMIS.

A NOTE ON ITS PHYSIOLOGY AND SURGERY.

BY CHARLES B. KEETLEY, F.R.C.S.,

OF LONDON, ENG.,

Senior Surgeon to the West London Hospital.

It used to be said that an unfavorable notice of a book in the *London Times* was better than no notice at all, and I think a similar view may be taken of a notice of one's work by Dr. William J. Mayo. That distinguished surgeon, in the Annals of Surgery for July, at p. 203, expresses himself emphatically as being in disagreement with what he supposes to be the views of Sir William Macewen and of myself as regards the surgery of the appendix.

In the first place, I am not aware that Sir William Macewen is in agreement with myself on the subject, because, on some points in it, he has not published his opinions. But I am quite sure that neither he nor I have said that the appendix should not be removed " unless absolutely necessary to save life." We both believe that many appendices are removed which might wisely be left, and I have attempted to state with precision what appendices the surgeon, for troubles of or about the appendix, is justified in removing. They are " (1) obliterated appendices; (2) tuberculous, actinomycotic, and cancerous appendices; (3) appendices gangrenous or perforated near the proximal end; (4) appendices of which the base cannot be brought up to the parietal peritoneum without undue tension; (5) those of which the meso-appendix is not long enough to permit them to be sufficiently straightened out or to be brought into the abdominal wall without dangerously interfering with their blood-supply; (6) appendices which cannot be placed in good position in the abdominal wall without interfering with such drainage as the case may require. An extremely thick and fat meso-appendix is unfavorable, but not

an absolute contraindication." (*The Lancet,* June 29, 1907, and January 2, 1909.)

The only reason which Dr. Mayo gives for rejecting the opinions of Macewen on the functional value of the appendix is that he (Dr. Mayo) " cannot believe that an organ of such exceptional value as they (*i.e.,* Macewen and Keetley) state the appendix to be would so early become atrophied were it endowed with so great a function." I wonder if Dr. Mayo cannot believe that the teeth are organs of value with a considerable function because in most people the best of them become a source of pain and of difficulty in mastication and even of dangerous illness long before the appendix vermiformis is obliterated. The adjectives " exceptional " and " great " are Dr. Mayo's and not mine. The only quality of the appendix to which I have ever applied a strong adjective is its potential surgical value.

And does the appendix become atrophied so early? I have tried to perform appendicostomy in 12 patients of 35 and upwards and have succeeded in 10, only 2 being " obliterated." At such ages as 50, 66, 75 and 78, I found the appendix not atrophied but easily dilatable to any desired extent. In the two eldest patients the appendices were used not simply to admit injections but to evacuate fæces and instead of cæcal colotomy.

Dr. Mayo himself agrees that only 3 to 4 per cent. of adults have completely obliterated appendices. And do not most of the organs of the body depreciate in functional value with age?

Again, the suggestion that I advocate, " the saving of a functionally useless organ which is so diseased as to contain abscesses, stones, etc.," has no justification. Dr. Mayo has probably been misled into this by the cases which I have reported in which concretions were removed and kinked ends amputated and the proximal parts of the appendices afterwards fixed in the abdominal wall. But these organs, after surgical treatment, were neither diseased nor functionally useless. To suggest that they were so is to beg the question and to flatly contradict my statements as to facts in my own published experience.

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Sir William Macewen carefully made and recorded observations throwing light on the physiology of the appendix, and he based on them, quite dispassionately, the opinion that the organ has a functional value which claims for it respectful treatment at the hands of the surgeon. I have tried to relate accurately a considerable number of cases in which the appendix instead of being amputated was transplanted into the abdominal wall with excellent results, and I have advised that this practice should be followed frequently, but not indiscriminately.

When will surgeons who do not like my views and do not like Sir William Macewen's, realize that before writing or speaking against them they ought (1) to understand them, (2) to represent them correctly, (3) to put some temporary restraint on ancient prejudice, and (4) to meet fact with either fresh fact, or with disproof. As to Dr. Mayo's final remark that " We are only just beginning to recognize that serious functional digestive disturbances such as pyloric spasm (appendicial dyspepsia), colic, etc., are often produced by a chronically diseased appendix," the fact that chronic appendicitis did cause such disturbances was expressly referred to in my first communication on transplanting the appendix, and I cannot believe that it has not been well known to Dr. Mayo as well as to myself for years. It supports the view that a diseased appendix should not be left in the body unless cured or at least put on the road to cure. But inasmuch as colitis is one of the troubles often associated with the chronically diseased appendix and appendicostomy is often a valuable step towards the cure of colitis, it also supports the view that one should not be in a hurry to cut away a healthy appendix or an appendix which though diseased can be cured.

A distinguished London abdominal surgeon, with the same opinions about appendix transplantation as Dr. Mayo, apparently arrived at in the same way, fell recently into the following absurdity. He recommended for the surgical treatment of chronic colitis (1) among other measures, appendicectomy, (2) as a last resource, if these failed, appendicostomy.

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CORRESPONDENCE.

THE BEGINNINGS OF THE ANNALS OF SURGERY.

Dr. Lewis S. Pilcher, Editor Annals of Surgery:

You request a brief note from me concerning the part which I was able to take in securing the continuation of the Annals of Surgery at a very critical period in its history. I had taken a deep interest in the old *Annals of the Brooklyn Anatomical and Surgical Society* from the first, and then watched its elaboration into the *Annals of Anatomy and Surgery* with great interest. In 1882 you did me the honor to make me one of the associate editors, a position in which I continued for a few years. This association led me to realize the difficulties under which you were placed, and the disproportionately small amount of interest which the surgeons and the profession generally in this country showed in the only surgical journal then published in English. In this way I learned of your discouragement, of your difficulty in finding a publisher, and of the probable discontinuance of the journal, which actually did occur for the period of one year.

Just at this time, in 1884, Mr. J. H. Chambers, a publisher of St. Louis, happened to inform me that he desired to issue some other medical publication beside the *Medical Gazette* (which he had bought of Dr. E. C. Dudley, who began it in Chicago), of which I was the editor. (This editorship, by the way, I held until my removal' to Buffalo, in 1883.) Later, Mr. Chambers endeavored to publish the *Medical Gazette* simultaneously in Chicago and St. Louis, with the result that after two or three years it became practically a St. Louis publication known as the *Weekly Medical Review,* now the *St. Louis Medical Review.* While talking with Mr. Chambers he displayed ambition to go still further into medical publication and I urged him to correspond with you. I judge that this correspondence was begun at an opportune time, since he shortly after began to publish the Annals of Surgery, and continued so to do until 1892. Just how great was the service so rendered to you and the profession in securing the revival of the Annals after its discontinuance it

is for you and for them to judge; such at all events were the actual facts.

Extending to you every congratulation upon the successful completion of a series of fifty volumes which are not exceeded in worth by any other set of equal number and similar character, and esteeming it an honor as well as a pleasure to have been associated with you in some part of its work, and again wishing you a continuation of the same remarkable success which has characterized the past, I am with every good wish,

<div style="text-align:center">Yours very sincerely,</div>

<div style="text-align:right">ROSWELL PARK.</div>

BUFFALO, N. Y., October 26, 1909.

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OF

SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

EDITED BY

LEWIS STEPHEN PILCHER, M.D., LL.D.,

OF NEW YORK.

WITH THE COLLABORATION OF

J. WILLIAM WHITE, M.D., LL.D.
OF PHILADELPHIA,
Professor of Surgery in the University
of Pennsylvania.

Sir WILLIAM MACEWEN, M.D., LL.D.
OF GLASGOW,
Professor of Surgery in the University
of Glasgow.

Sir W. WATSON CHEYNE, C.B., F.R.S.,
OF LONDON,
Professor of Surgery in King's College.

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CONTRIBUTORS TO VOLUME L.

BARLING, GILBERT, M.B., F.R.C.S., of Birmingham, England, Surgeon to the Birmingham General Hospital.

BASTIANELLI, PROF. RAFFAELE, of Rome, Italy.

BELL, JAMES, M.D., of Montreal, Canada, Professor of Surgery McGill University; Surgeon to the Royal Victoria Hospital.

BERNHEIM, BERTRAM M., M.D., of Baltimore, Md., The Hunterian Laboratory of Experimental Medicine, Johns Hopkins University.

BLAKE, JOHN BAPST, M.D., of Boston, Mass., Instructor in Surgery in Harvard University; Assistant Surgeon to the Boston City Hospital.

BREWER, GEORGE EMERSON, M.D., of New York, Surgeon to the Roosevelt Hospital.

BRISTOW, ALGERNON T., M.D., of Brooklyn, New York, Surgeon to the Long Island College, Kings County and St. John's Hospitals.

BRYAN, ROBERT C., M.D., of Richmond, Va., Professor of Descriptive Anatomy and Genito-Urinary Surgery in the University College of Medicine; Visiting Surgeon to Virginia Hospital.

BRYANT, JOSEPH D., M.D., of New York, Surgeon to Bellevue and St. Vincent's Hospitals.

BUERGER, LEO, M.D., of New York, Associate in Surgical Pathology and Assistant Adjunct Surgeon Mt. Sinai Hospital.

CHAFFEE, I. S., M.D., of Sharon, Conn.

CLARK, GEORGE O., M.D., of Boston, Mass.

COFFEY, ROBERT C., M.D., of Portland, Oregon.

COLEY, WILLIAM B., M.D., of New York, Attending Surgeon to the General Memorial Hospital; Attending Surgeon to the Hospital for Ruptured and Crippled.

CUSHING, HARVEY, M.D., of Baltimore, Associate Professor of Surgery in Johns Hopkins Hospital.

DAVIS, JOHN STAIGE, M.D., of Baltimore, Md., Assistant Surgeon to the Outpatient Department of the Johns Hopkins Hospital.

DEAVER, JOHN B., M.D., LL.D., of Philadelphia, Surgeon-in-Chief to the German Hospital.

DOBSON, J. F., M.S., F.R.C.S., of Leeds, Eng., Senior Assistant Surgeon to the Leeds General Infirmary.

DOWD, CHARLES N., M.D., of New York, Attending Surgeon to the General Memorial Hospital and St. Mary's Hospital for Children; Adjunct Professor of Clinical Surgery in Columbia University.

DOWNES, WILLIAM A., M.D., of New York, Associate Attending Surgeon to the New York Hospital; Assistant Surgeon to the General Memorial and St. Francis Hospitals; Instructor in Surgery Cornell University Medical College.

DUVAL, C. W., M.D., of Montreal, Canada.

EBERTS, EDMOND M. VON, M.D., M.R.C.S.(Eng.), of Montreal, Surgeon to the Outpatient Department of the Montreal General Hospital.

EISENDRATH, DANIEL N., M.D., of Chicago, Ill., Professor of Surgery in the College of Physicians and Surgeons of Chicago; Attending Surgeon of the Michael Reese and Cook County Hospitals.

FINNEY, JOHN M. T., M.D., of Baltimore, Md., Associate in Surgery in the Johns Hopkins Hospital.

FREEMAN, LEONARD, M.D., of Denver, Colo., Professor of Surgery in Denver and Gross Colleges of Medicine.

FRIEDRICH, P. L., PROFESSOR DR., of Marburg, Germany, Professor of Surgery in the University of Marburg.

GIBBON, JOHN H., M.D., of Philadelphia, Professor of Surgery in Jefferson Medical College; Surgeon to the Pennsylvania Hospital.

GROVES, ERNEST W. HEY, M.S., F.R.C.S., of Bristol, England, Assistant Surgeon to the Bristol General Hospital; Surgeon to the Cossham Memorial Hospital.

GUTHRIE, DONALD, M.D., of Rochester, Minn., Clinical Assistant in St. Mary's Hospital.

HARTMANN, HENRI, M.D., of Paris, France, Professor in the Faculty of Medicine of Paris.

HARTWELL, H. F., M.D., of Boston, Mass., From the Pathological Laboratory of the Massachusetts General Hospital.

HENDERSON, M. S., M.B., of Rochester, Minnesota, Surgical Assistant at St. Mary's Hospital.

HITZROT, JAMES MORLEY, M.D., of New York City.

HOTCHKISS, LUCIUS W., M.D., of New York, Attending Surgeon to the Bellevue Hospital; Junior Surgeon to the Roosevelt Hospital.

HUME, JOSEPH, M.D., of New Orleans, La.

HUTCHINGS, WILLARD, M.D., of Detroit, Mich.

JAMIESON, J. KAY, of Leeds, Eng., Demonstrator of Anatomy in the University of Leeds.

JOHNSON, ALEXANDER B., M.D., of New York, Surgeon to the New York Hospital.

JONES, ROBERT, F.R.C.S., of Liverpool, Eng.

JUDD, JAMES R., M.D., of Honolulu, Hawaii.

KEETLEY, CHARLES B., F.R.C.S., of London, Eng., Senior Surgeon to the West London Hospital.

KELLY, HOWARD A., M.D., of Baltimore, Md., Professor of Gynæcologic Surgery in Johns Hopkins University.

LANE, W. ARBUTHNOT, M.S.(Lond.), F.R.C.S.(Eng.), of London, Surgeon to Guy's Hospital; Senior Surgeon to Hospital for Sick Children, Great Ormond Street.

LECONTE, ROBERT G., M.D., of Philadelphia.

LESTER, B. S., M.D., of Birmingham, Alabama.

LEWIS, JOSEPH S., M.D., Intern at the German Hospital in the City of New York.

LUCKETT, WILLIAM HENRY, M.D., of New York City.

MACEWEN, SIR WILLIAM, F.R.S., of Glasgow, Regius Professor of Surgery in the University of Glasgow.

MACKENZIE, KENNETH A. J., M.D., L.R.C.P. and S.E., of Portland, Oregon, Professor of Operative Surgery in the University of Oregon; Surgeon to St. Vincent's Hospital.

MACLAREN, ARCHIBALD, M.D., of Saint Paul, Minnesota, Professor of Clinical Surgery in the University of Minnesota.

MACLEAN, N. J., M.D., M.R.C.S(Eng.), of Winnipeg, Manitoba, Surgeon to St. Boniface Hospital and the Children's Hospital of Winnipeg.

MASON, J. M., M.D., of Birmingham, Alabama.

MAYO, CHARLES H., M.D., of Rochester, Minnesota, Surgeon to St. Mary's Hospital.

MAYO, WILLIAM J., M.D., Rochester, Minnesota, Surgeon to St. Mary's Hospital.

McGRAW, THEODORE A., M.D., of Detroit, Mich., Professor of Surgery in the Detroit College of Medicine; Surgeon to St. Mary's and the Harper Hospitals.

MEARS, J. EWING, M.D., of Philadelphia.

MEYER, WILLY, M.D., of New York, Professor of Surgery at the New York Postgraduate Medical School and Hospital; Attending Surgeon to the German Hospital; Consulting Surgeon to the New York Skin and Cancer Hospital and New York Infirmary.

MORISON, RUTHERFORD, M.B., F.R.C.S., of Newcastle-on-Tyne, Senior Surgeon Royal Victoria Infirmary; Lecturer on Surgery and Operative Surgery University of Durham College of Medicine.

MOYNIHAN, B. G. A., M.S., F.R.C.S., of Leeds, England, Surgeon to the Leeds Infirmary.

MULLER, GEORGE P., M.D., of Philadelphia, Associate in Surgery in the University of Pennsylvania; Assistant Surgeon to the University Hospital; Consulting Surgeon to the Chester County Hospital.

MURRAY, FRANK W., M.D., of New York, Surgeon to the New York Hospital.

NANCREDE, CHARLES B. G. DE, M.D., Ann Arbor, Mich., Professor of Surgery in the University of Michigan and Dartmouth Medical College.

NEWMAN, SAMUEL E., M.D., of St. Louis, Mo.

OCHSNER, ALBERT J., M.D., of Chicago, Surgeon-in-Chief of Augustana and Saint Mary's Hospitals.

OPPENHEIMER, ADELE, M.A., of New York, Volunteer in Surgical Pathology, Mount Sinai Hospital.

PARHAM, FREDERICK W., M.D., of New Orleans, La.

PATERSON, HERBERT J., M.B., B.C.(Cantab.), F.R.C.S., of London, Assist-

ant Surgeon of the London Temperance Hospital, formerly Hunterian Professor of Surgery, Royal College of Surgeons.

PAUL, WALTER E., M.D., of Boston, Mass., Assistant Physician of Nervous Diseases to the Massachusetts General Hospital.

PECK, CHARLES H., of New York City, Attending Surgeon French Hospital; Junior Attending Surgeon Roosevelt Hospital; Adjunct Professor of Clinical Surgery in Columbia University.

PEDERSEN, VICTOR COX, M.D., of New York, Genito-urinary Surgeon of the Outpatient Department of the New York Hospital and House of Relief (Hudson Street Hospital).

PHELPS, CHARLES, M.D., of New York City, Surgeon to Bellevue and St. Vincent's Hospitals.

PORTER, CHARLES A., M.D., of Boston, Mass., Surgeon in the Massachusetts General Hospital.

POWERS, CHARLES A., M.D., of Denver, Colo.

PRIMROSE, ALEXANDER, M.B., C.M.(Edin.), M.R.C.S.(Eng.), of Toronto, Canada, Associate Professor of Clinical Surgery, University of Toronto; Surgeon, Toronto General Hospital.

RANSOHOFF, JOSEPH, M.D., F.R.C.S.(Eng.), of Cincinnati, Professor of Surgery in the Medical College of Ohio, University of Cincinnati.

ROVSING, THORKILD, M.D., of Copenhagen, Denmark, Professor of Clinical Surgery to the University of Copenhagen.

ROGERS, JOHN, M.D., of New York, Surgeon to the Gouverneur and St. Francis Hospitals.

SCUDDER, CHARLES L., M.D., of. Boston, Mass., Surgeon to the Massachusetts General Hospital.

SHEPHERD, FRANCIS J., M.D., of Montreal, Canada.

SHERREN, JAMES, F.R.C.S., of London, Assistant Surgeon to the London Hospital; Surgeon to the Poplar Hospital for Accidents.

SMITH, CHARLES N., of Toledo, Ohio, Gynæcologist to St. Vincent's Hospital.

SMITH, EUGENE A., M.D., of Buffalo, N. Y., Adjunct Professor of Clinical Surgery in the University of Buffalo.

STOW, BOND, M.D., of New York, Pathologist to the Metropolitan Hospital of New York.

VAN METER, S. D., M.D., of Denver, Colo.

VANDER VEER, ALBERT, M.D., of Albany, New York, Professor of Surgery in the Albany Medical College.

WARE, MARTIN W., M.D., of New York City, Adjunct Surgeon to Mt. Sinai Hospital.

WIENER, JOSEPH, M.D., of New York, Adjunct Surgeon Mount Sinai Hospital.

WILSON, LOUIS B., M.D., of Rochester, Minn., Pathologist and Director of Laboratories in St. Mary's Hospital.

WROTH, PEREGRINE, JR., M.D., of Hagerstown, Md.

YOUNG, HUGH HAMPTON, M.D., of Baltimore, Md., Associate Professor of Genito-Urinary Surgery to the Johns Hopkins University; Associate in Surgery to the Johns Hopkins Hospital.